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THE "CLEANSING" OF AEC FELLOWSHIPS

THE preceding issue of the *Bulletin* was largely devoted to the "purge" of geneticists in the Soviet Union. In several articles, attention was drawn to the lesson these events hold for the future of science in this country.

The present issue contains reports and articles dealing with the controversy over the admission of avowed or suspected Communists or Communist sympathizers to nonsecret research fellowships of the Atomic Energy Commission. We do not suggest that this is a counterpart of the Soviet purge. Not only is the loyalty to a political system imposed there in an infinitely more rigid and ruthless way, but the requirement of conformity is extended from the political field into that of science itself, even though the government-sponsored theory contradicts all scientific experience.

Nevertheless, cleansing the AEC fellowship program of "subversive" elements is a step onto the dangerous path, the end of which is illuminated by the lurid light of the Soviet purge. It is the first invasion of the scientific and educational life of America, outside the circumscribed field of secret research, by government-imposed political discrimination.

With an increasing part of scientific research at American universities and private laboratories becoming directly or indirectly dependent on Federal monetary aid or government contracts, the acceptance of the principle: "No state money to educate or support research by enemies of the State" has implications far beyond the field of AEC fellowships. Senator Hickenlooper, the spearhead of the attack on Mr. Lilienthal, has stated that this principle should apply to the recipients of grants by the projected National Science Foundation. We might easily be led to a situation in which most, if not all, students entering advanced training in wide fields of physics, chemistry, or biology will have to be investigated and cleared by the FBI, to weed out "poor security risks." And what is necessary to keep the body of science students "pure," should be at least equally important as applied to science teachers and independent research men. Not only will they have to be "cleared" before admittance to even nonsecret research involving the expenditure of government funds, but they will have to be periodically reinvestigated, to make sure that they have not newly acquired subversive ideas or undesirable associations.

A short while ago, college teachers were alarmed by the action of a western college president who terminated the appointment of a chemistry professor because he had publicly pleaded for fair hearing for Lysenko's theories. The president argued that this plea proved that the teacher was following "Party Line" in science and therefore could not be a good chemist —despite a testimonial to the contrary by the President of the American Chemical Society. This kind of discrimination on a local or private plane will be greatly stimulated if Congress makes FBI clearance prerequisite for participation in nonsecret research directly or indirectly supported by government funds. A chemistry or physics professor who could not be "cleared" would be considered a liability by many college authorities.

This kind of apprehensiveness was behind the statements which prominent American scientists and educators, including the President of the National Academy of Sciences, made before the Joint Committee on Atomic Energy. It was clear that even the most conservative and outspokenly anti-Communist of them came to testify in favor of the AEC's original policy of making scientific ability the only criterion for granting research fellowships in nonsecret fields. But the witnesses wavered when they were confronted with almost unanimous congressional indignation (shared by many legislators with liberal reputations, such as Senators O'Mahoney and Saltonstall) over the award of one such fellowship to an active member of the Communist Party, Mr. Freistadt, and with the superficial logic of the argument: "Government funds should not be used to train the enemies of the state in nuclear science." The President of the National Academy suggested as a "compromise" that the selection of candidates by the National Research Council be based on ability alone, but that the subsequent granting of fellowships by the AEC

be made conditional on the signing of an oath of allegiance and a non-Communist affidavit. Under the pressure of attack, the Atomic Energy Commission accepted this suggestion. However, this failed to satisfy the critics. They pointed out—rightfully—that oaths and affidavits are useless in weeding out the really "subversive" elements. Senator O'Mahoney, Chairman of the Senate Appropriations Committee, expressed his intention of making a full FBI investigation of all applicants the pre-condition for granting fellowship funds to the AEC.

IT IS an unpopular and ungrateful task to defend the rights of Communists to enjoy the privileges of a democratic society. Being themselves fundamentally opposed to tolerance, nondiscrimination, and independence of science and education from political dogma, Communists have no moral justification for claiming these rights for themselves. If these freedoms still exist, it is only because of their own failure to date to destroy them. This does not mean, however, that non-Communists, who genuinely believe in a free society, have no right—or for that matter, no duty—to insist that freedom of thought, teaching, and research, and equality in educational opportunity, must be accorded to *all citizens*, including those harboring "subversive" convictions.

In times of war, or danger to national security, constitutional rights of citizens, even in the freest country, may have to be restricted or suspended. It would be quixotic to insist that these freedoms cannot be temporarily curtailed when this is needed to preserve them for the future. But freedom can be lost in more than one way. It can be lost by victory of a totalitarian power; it can also be lost by waning belief in its inherent strength, by giving it up too willingly and too easily, to satisfy fear, hysteria, and other political passions. The way to keep freedom is not to relinquish it except when the need for this sacrifice is limited, concrete, and compelling. This may be the case under the present conditions, in the clearance regulations protecting the atomic energy laboratories. It is assuredly not the case in the discrimination against Communists or fellow-travellers in the college faculties, or in research training, whether at private or at government expense. In these fields, political passions, whether they arise from reactionary prejudice, or from genuine concern for the future of free society endangered by Communism, should not be permitted to take precedence over the fundamental principle of freedom of thought. It is difficult to see how this principle can be preserved if the judgment as to whether an individual should be assisted in his education, permitted to teach in a college, or to pursue nonsecret research, does not remain founded entirely on his demonstrated ability to learn, to teach, or to explore in the field he has chosen. Only if a teacher of social science uses his classes for Communist (or other) propaganda, instead of objective presentation of facts, or if a teacher of genetics feeds his students the ideology of the "new Soviet biology" while concealing from them the facts and theories of scientific genetics, does the question of his fitness as a teacher legitimately arise.

We live in a period in which a series of world-wide wars, the progress of military technology, and the emergence of a variety of totalitarian political systems, partly forces and partly induces even those nations which have created and long maintained the standards of freedom and equality, to accept discriminatory police-state procedures which would have appeared revolting to them only a generation ago. If the arms race is to continue, many more such concessions will have to be countenanced in the years to come. It is vitally important that public opinion and political leadership do not learn to take these concessions lightly; in fact, do not begin to like them, because they make the job of ruling the country and confounding inconvenient opposition so much easier. Whenever political or individual rights are curtailed—even if these be the rights of the enemies of democracy—the question may be asked: Is this restriction compellingly necessary for the security of the nation? If not, the principles of freedom must prevail over political expediency.

In the particular case of educational grants to science students, many other considerations enter: the natural radicalism of inquiring youth, which is attracted by new ideas in both science and politics—a radicalism which usually gives place to more mature discrimination in later years; the shortage of good material for top scientific achievement; the advantages to science and to the nation as a whole, from a new scientific discovery, whether made by a democrat, Fascist, or Communist; the fact that social or racial discrimination often drives intelligent youth into a revolutionary camp, and may keep it there in the later years, if it is followed by discrimination against political radicalism in the lecture theater and laboratory—all these points have been eloquently presented to the Joint Congressional Committee on Atomic Energy in the testimonies, excerpts from which are printed elsewhere in this issue.

In vain: The political hysteria aroused by a combination of the words "Communist" and "atomic energy" has forced the AEC and the National Research Council into a first retreat. The fight for the preservation of independence and integrity of American education and scientific research in the field of science will not be avoided by this "compromise." Since the rights of Communists or Communist sympathizers are involved, it will be an unpopular issue; but it is one on which scientists and educators must make a stand.

THE attack on the AEC, which has begun with the "revelation" of the Freistadt fellowship, has been expanded by Senator Hickenlooper into a general accusation of "mismanagement" and a request for resignation of Mr. Lilienthal. This accusation has been answered by Mr. Lilienthal with a request for a full-dress investigation of the AEC activities. Unless the hearings reveal shortcomings much more significant than the incidents which have led to the attack—the fellowship policy, and the shortage of a small amount of enriched uranium at the inventory of the Argonne National Laboratory in Chicago —Senator Hickenlooper and his supporters may find themselves guilty of inflicting grievous damage to the nation's atomic energy program for reasons of political partisanship. However, since hearings are now in progress, we must postpone judgment until they are completed.

—E. R.

A LETTER TO SENATOR MCMAHON

J. Robert Oppenheimer

This letter from one of America's most distinguished scientists to the Chairman of the Joint Congressional Committee on Atomic Energy, was introduced at the Committee hearings on the AEC fellowship program on May 17.

DEAR SENATOR MCMAHON:

From the press, and directly from the Atomic Energy Commission, I have learned of the recent discussions about the Commission's fellowship program, which raise the question of whether candidates for fellowships supported by funds from the Commission should or should not be subject to investigation and clearance procedures. It seems to me that this question, and the implications of the decisions here taken with regard to the Federal support of science and education generally, are closely related to many of the great issues on which you have taken so constructive and farseeing a position. I am writing to you in the hope that in one way or another it may prove helpful to you to have an expression of my views. The question at issue clearly does not present some of the grave and often tragic aspects that the maintenance of security on secret technical work has brought so prominently to the forefront. For this reason, I have come to believe that we can and should deal with it unequivocally.

1. The present situation, as I understand it, is this: The Atomic Energy Commission has advanced funds to the National Research Council, and has asked the National Research Council to use these for the granting of fellowships. In making this request, the Commission has asked the Council to pursue its traditional methods of selecting fellows. In this selection, considerations of scientific and intellectual competence play a decisive part. Considerations of character are not excluded; but, in the past, no effort has been made by the National Research Council to determine the political views, sympathies, or associations of candidates. My understanding is that the Commission has accepted this procedure and has endorsed it. With the basic wisdom of this decision, I fully agree.

2. In considering the issue, we need first to ask ourselves what effects we can anticipate if, from time to time, young men and women who are Communists, or who have Communistic sympathies or associations, are in fact granted fellowships. The fellowships are, of course, in fields where no access to restricted data will be needed or granted; and there can be no question of any jeopardy to security. What is more, there is no direct commitment, and no implication, that recipients of the fellowships will later be engaged in secret work. The Commission does not require this, nor do the research fellows. As a matter of fact, only a small fraction of the scientists of the country can or should be engaged in such secret work. The Scientific Panel of the Secretary of War's Interim Committee at one time estimated that even in the fields of the greatest relevance, not more than 15 per cent of our scientists would be associated with the atomic energy programs; and of these, of course, many will be concerned with their nonclassified aspects. The actual practices of the Commission bear out these predictions. Thus one must ask the question of whether it is a proper charge upon the Federal Government, and upon the Atomic Energy Commission in particular, to support the training and research of men who will not be directly involved in the work of the Commission. It is the Commission's opinion, and this is an opinion fully shared by the General Advisory Committee, that the answer to this question is in the affirmative. For basic work in science, in aspects which are not and may not be under the direct control of any one Federal agency, is, nevertheless, a major source of our scientific progress, of invention, discovery, and technical leadership.

There are many examples of discoveries basic to the present work of the Atomic Energy Commission which were in fact made by Communists or Communist sympathizers. Of these many examples, we may cite a famous one: The major—one might almost say the only—present peaceful application of atomic energy rests on the preparation and use of artificial radioactive materials, which were discovered by Joliot, who is a Communist, and by his wife, who is a Communist sympathizer. It would be folly to suppose that the United States would be the stronger, or our science and industry the more vigorous, if this discovery had not been made. It would be contrary to all experience to suppose that only those who throughout their lives have held conformist political views would make the great discoveries in the future. The people and the Government of the United States have a stake in scientific discovery and invention; and it is for this stake, rather than as an act of benevolence toward the recipients of the grants-in-aid, that one must look for justification for having a fellowship program at all.

3. The argument given above would seem to me a cogent ground for maintaining the Commission's policy, even if the determination of loyalty and reliability could be made by the most straightforward and satisfactory methods. As you well know, the actual procedures which have been employed, and which perhaps must be employed, in order to establish the loyalty of an applicant, are far from simple and far from satisfactory. They involve secret, investigative programs which make difficult the evaluation and criticism of

(Continued on page 178)

In This Issue

The "Cleansing" of the AEC Fellowship Program 161

A Letter to Senator McMahon
J. Robert Oppenheimer 163

Washington Notes: AEC Under Fire
Anne W. Marks 164

The Fellowship Program: Testimony Before the Joint Committee 166

The AEC Fellowships: Shall We Yield or Fight?
Leo Szilard 177

Reflections on Government
Edward U. Condon 179

Hickenlooper v. Lilienthal 182

FAS Announces Policy Decisions 184

Psychology and Structure of Large-Scale Physical Research
L. Kowarski 186

Science, Materialism, and the Human Spirit—a Symposium
Percy W. Bridgman 192
Julius S. Bixler 194
Walter T. Stace 197
Jacques Maritain 199

Why Another Cyclotron?
L. A. DuBridge 201

"Histopathology of Irradiation"
Reviewed by Shields Warren 204

The present issue constitutes a double number—Volume V, Nos. 6 and 7.

WASHINGTON NOTES: AEC UNDER FIRE

Anne Wilson Marks

In this article, Mrs. Marks, Washington correspondent for the **Bulletin,** summarizes the events in Washington which began with the discovery that an avowed Communist had been awarded an AEC fellowship and ended with the demand for a full-scale investigation into the work of the Commission.

May 30, 1949

UP ON Capitol Hill this month, a couple of congressmen put the kettle on to boil. And within two short weeks the Atomic Energy Commission was up to its neck in the soup, a full dress congressional investigation.

The incident which precipitated the controversy took place on May 12, when Representative Cole, of New York, one of the ranking Republicans on the Joint Committee on Atomic Energy, introduced into the *Congressional Record* the script of a radio broadcast by Fulton Lewis, Jr., who has been taking pot shots at the AEC for some months. The substance of it was that Hans Freistadt, a naturalized citizen and a Communist, was studying at the University of North Carolina under an Atomic Energy Commission fellowship. That same day, on the Senate side, Clyde Hoey, of North Carolina revealed the same information, saying he had heard about Mr. Freistadt from an unidentified student at the University.

Senator Hoey demanded that the Joint Committee look into the matter immediately.

As it happened, confirmation hearings were then being held on the nomination of Professor H. D. Smyth to the Atomic Energy Commission. Senator Hickenlooper questioned the witness closely about his views on Commission security procedures generally, and the fellowship program specifically. Surely, said the ex-Chairman of the Joint Committee, the weeding out of a small minority who could not be cleared for access to restricted data anyway would not hurt the program. Professor Smyth replied with a question: "What would you feel about similar fellowships, set up, let's say, by a National Science Foundation, where the individuals would also be supported by public funds?" Senator Hickenlooper said he would feel the same way.

Because of the immediate and intense public interest in the Freistadt incident, Senator McMahon announced that he would put aside the confirmation hearings for the moment in order that the committee might look into the matter of Communists holding fellowships.

In the days that followed the incident snowballed. On Monday, May 16, Mr. Lilienthal appeared before the Joint Committee and vigorously defended the Commission's policy of not inquiring into the political affiliations of those working in the fellowship program. Dr. A. N. Richards, President of the National Academy, appeared with him. On Tuesday, Dr. D. W. Bronk, Chairman of the National Research Council, which is directly responsible for administering the fellowships, appeared. Dr. Alan Gregg, Chairman of the AEC's advisory committee on Biology and Medicine, testified at his own request.[1]

It was at this point that the story of the lost uranium broke. The morning editions of the *New York Daily News* for Wednesday, May 18, reported in scare headlines: ATOM BOMB URANIUM VANISHES!

At ten A.M. that morning Hans Freistadt appeared before the Joint Committee. By this time atomic energy was front page news and the committee rooms were crowded with spectators. In the afternoon the committee went into executive session to consider the matter of the missing uranium.

Adding to the confusion caused by the dual sensations, a conflict of jurisdiction developed between the Joint Committee and a Senate appropriations subcommittee, which was inquiring into the fellowship matter in connection with review of the AEC's annual budget request. On May 19th and 20th both committees heard substantially the same witnesses on the same subjects. The AEC was faced, on the one hand, with an irate Joint Committee, and, on the other, with an imperilled budget and the possibility of an appropriation "rider" requiring full FBI investigations of all fellowship applicants.

The AEC, perhaps miscalculating the extent of the security hysteria in Congress, tried to handle the affair of the lost U-235 in a calm and judicious manner, and was immediately accused of "nonchalance." By the end of the week, the Commission found itself in a hopeless muddle of confusion.

The first casualty was the AEC policy on fellowships. Mr. Lilienthal was forced to accept a compromise. In his original appearance before the Joint Committee in defense of the program, he seems to have assumed that he was voicing not only the policy and conviction of the Commission, but that of the National Academy of Sciences, the National Research Council, and students and educators as well. In his prepared statement to the committee he said:

"We see no easy solution. If we can't rely on the judgment of a private, nongovernmental agency, the National Research Council, to select these fellows on the basis of ability and of their indications of great promise in the future, and without consideration of the political and economic views of such potential fellows, we fear it would invite the danger of the Federal Government itself tying strings related to political and economic views and opinions, to educational funds."

But when Dr. Richards followed Mr. Lilienthal to the witness chair, he testified that he thought the fellowship award to Freistadt was a mistake, and that while he was opposed to FBI investigation of fellows not having access to secret work, he was now suggesting to the Commission that after an award was made the recipient should be required to sign a loyalty oath. What Dr. Bronk had to say added up to substantially the same thing, which just about settled it.

By the time Dr. Smyth was recalled for his confirmation hearings, he was looking at a lost cause. Gordon Dean, the other nominee to the Commission, appeared also, and both agreed that it would be wise to provide some kind of safeguards to minimize the risk of selecting a Communist for a fellowship.

[1] At the meeting of May 17, the letter from Dr. Robert Oppenheimer, published on p. 163 of this issue, was read aloud to the Committee.

Senator McMahon certainly couldn't have been expected to climb out on a limb which had already been sawed off; he told the Senate that it was "the opinion of the Joint Committee" that public funds should not be used to educate members of the Communist Party.

SENATOR O'Mahoney, chairman of the appropriations subcommittee, voiced the obviously unanimous sentiments of both committees:

"There is a confusion of issues here. It is not a question of whether an individual may attend a school or speak freely. The issue is whether the Atomic Energy Commission shall use public funds to educate persons who are members of an organization pledged to overthrow the government."

Lilienthal was forced to concede the point. He told the subcommittee that the Commission would henceforth require a loyalty oath and a non-Communist affidavit from all students participating in the program. Important sectors of the press, conservative and progressive alike, discerned serious dangers in the compromise—"dangers involved in the establishment of Federal qualifications for access to education." But if any member of Congress thought the problem confronting the AEC was any more complicated than Senator O'Mahoney had said, he was careful to keep his thoughts to himself. And at this stage, with a few exceptions like Gregg and Oppenheimer, the scientific community appeared ready to accept the compromise.

But Lilienthal's concession did nothing towards easing the tension. On the contrary, it served only to step up the attacks. Mr. Arthur Krock of the *New York Times* used the occasion to strike at the Commission on a new front, referring to evidence of "muzzy-mindedness and deliberate evasion" in the administration of the law, internal dissension within the Commission (especially over the foreign distribution of radio-isotopes), and "private reports . . . of shipments of fissionable material to foreign areas which are under influences dangerous to this country." Senator Vandenberg is reported to have said that while Lilienthal was an able administrator, "these security phases are paramount."

Then on Sunday, May 22, Senator Hickenlooper made public an open letter to the President demanding the resignation of David Lilienthal.[2] He charged "incredible mismanagement," "misplaced emphasis," and "maladministration."

BRIGHT and early Monday morning the Joint Committee went back to hearings, and the excitement started into its second week. In the morning the Committee listened to Dr. Zinn's account of the uranium loss, and in the afternoon to Dr. Edelman's denial that he was another Communist fellow, as charged by Senator Hickenlooper. McMahon announced that the Committee would hire an outside consultant to try and hunt up the missing material; Edelman went over to the appropriations subcommittee with his story. That body not only heard him, but also held an executive session to hear Commissioner Strauss describe his disagreement with the majority of the Commission—long a matter of open gossip—on the foreign distribution of radioisotopes.

But the AEC's situation was no longer a series of unrelated incidents to be pecked at piecemeal by angry congressional committeemen. With Senator Hickenlooper's week end attack on the AEC Chairman, the battle had entered an entirely new phase. The difficulties of the Commission were now so manifest that it became fair game for every legislator on the Hill with a pet interest in some aspect of the atomic energy enterprise. The Lilienthal-haters saw new and beautiful possibilities of discrediting him; Senator Wherry even stated that his removal might be made a matter of Republican policy. The press galleries buzzed with speculation about whether the whole affair was a gigantic plot. The Montana delegation, which had been trying to get the Commission to change its decision on the Idaho reactor site in favor of Fort Peck, howled for a further investigation of that issue. Advocates of military control began drafting legislation to turn atomic energy back to the military, and Senator Cain prepared a bill to abolish the present Commission and set up a new one consisting of the four Secretaries of the National Defense Establishment, the three Chiefs of Staff, and one scientist. There were hints of malcontents within the Commission and among ex-employees.

CONGRESS had a bad case of jitters. The best measure of how bad, was the behavior of Lilienthal's usually staunch friends and supporters in the Capitol. Either they remained silent or made only the most cautious and guarded statements in his behalf. His stock, and that of the Commission, was at a new low, and the seriousness of the situation was at last unmistakably clear.

Fortunately, the press had a much clearer view of affairs than most Congressmen. On May 24th, three of the leading newspapers in the country carried editorials—startlingly similar in content—which went to the heart of the matter.

"Mr. Hickenlooper," said the *Washington Post*, was "merely restating an old grudge" against Mr. Lilienthal. But in one aspect his "fulminations reflect a healthy suspicion." Congress "suffers from the same frustrations as other Americans in trying to appraise the Atomic Energy Commission," it went on. "There are no objective criteria by which to judge its work; and the spotlight of publicity and public criticism, which keeps tabs on other agencies, is absent here." But, as the N. Y. *Herald Tribune* emphasized, "the more that 'security' is insisted upon, and its maintenance investigated, the fewer facts there will ever be on which the public may form a valid opinion of the Atomic Energy Commission's stewardship." The *Times* insisted that no congressional inquiry of specific incidents would be complete or candid unless it looked into the broad question of how well or how poorly the Atomic Energy Commission had done its work as a whole.

THE next day Chairman Lilienthal, in a formal communication to Senator McMahon,[3] demanded a full investigation of the entire Atomic Energy Commission stewardship. Senator McMahon made the letter public and announced that his committee would start open hearings immediately.

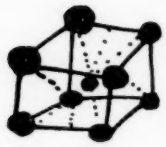
Twelve members of the Joint Committee—an almost unprecedented number—showed up for the first hearing in the investigation. The Caucus Room of the Senate Office Building was jammed with press and spectators. Mr. Lilienthal, as the first witness, stated the issues clearly. The big question, he pointed out, is how "American self-government can function despite the need for secrecy." His testimony consisted of precise and detailed suggestions as to the procedure by which a full investigation could be made, for the most part in open hearings, without impairing security and in a manner calculated to give the Congress and the public a basis for judging the Commission's work.

He asserted that a full accounting could be made "to the country without the revelation of any secret information." He suggested that it could be

(Continued on page 181)

[2] P. 182 of this issue.
[3] P. 185 of this issue.

THE FELLOWSHIP PROGRAM: TESTIMONY BEFORE THE JOINT COMMITTEE



A chronological account of the proceedings, extracts from which appear below, has been given by Mrs. Marks in the preceding article. The following testimony was given before the Joint Congressional Committee on Atomic Energy, on May 16 and 17. Mr. Lilienthal's evidence is followed by that of three educators. Dr. A. Newton Richards is President of the National Academy of Sciences. Dr. Detlev W. Bronk, President of Johns Hopkins, is Chairman of the National Research Council (the body which administered the fellowship program under contract with the AEC, and an agency of the National Academy of Sciences). Dr. Alan Gregg is head of the Advisory Committee on Biology and Medicine of the AEC and Director for Medical Science of the Rockefeller Foundation.

BACKGROUND OF THE CONTROVERSY

Nearly a year ago, Senator Hickenlooper, then Chairman of the Joint Committee, asked for and received a statement of the views of the Atomic Energy Commission on loyalty clearance for fellowship candidates. The correspondence between the Senator and the Commission, together with a letter on this subject written by the Chairman of the National Research Council, follows:

July 30, 1948

Mr. David E. Lilienthal, Chairman
Atomic Energy Commission

The fellowship program of the Atomic Energy Commission has been reviewed by various members of the Joint Committee. The question has arisen as to the nature of the investigation, if any, which is performed on the character, loyalty, and associations of these individuals prior to the awarding of such fellowships.

Unless an investigation is performed, is it conceivable that we may someday find ourselves in the position of having, with government money, subsidized the education of a potential subversive who is not eligible for employment on the atomic energy program?

The Joint Committee will appreciate a statement of the views of the Atomic Energy Commission on this subject.

B. B. HICKENLOOPER

August 24, 1948

Hon. Bourke B. Hickenlooper
Chairman, Joint Committee on Atomic Energy

This matter has been under continuous review by the Commission and its staff. We had hoped at this time to be able to furnish you with a complete report, but now find that the Commission will not be in a position to discuss it again until its next regular meeting which is now scheduled for early in September. At that time we shall give you a full statement of our views.

SUMNER T. PIKE

October 11, 1948

Hon. B. B. Hickenlooper
Chairman, Joint Committee on Atomic Energy

You will recall that we wrote you on August 24 and advised you that we were working on a statement of our views for submission to the Joint Committee.

As you know, the National Research Council was selected for administration of the fellowship programs in view of its long and distinguished record in such work.

In order to assure the selection of well-qualified fellows, the National Research Council has established fellowship boards.

These boards were chosen by the National Research Council particularly with a view to their ability to evaluate the scientific promise and moral character of prospective fellows. In considering applications, the fellowship boards have before them confidential reports on the candidate which are received from men of proved scientific ability, who are familiar with the candidate, and in whom the fellowship boards have confidence. In the deliberations of the fellowship boards, we understand that careful consideration is given to the question of character.

Before any fellow is given access to restricted data or permitted to work on a Commission project where security clearance is normally required, the usual AEC security clearance must be obtained.

On the other hand, if the fellow does not have access to restricted data or does not work on a Commission project where security clearance is normally required, it is our policy that security clearance need not then be obtained. Some of the reasons underlying this policy are enumerated below.

a) The Commission has confidence in the methods of selection followed by the National Research Council, which are in line with the experience accumulated by the Council over the last twenty-five years in handling National Research Council fellowships.

b) To a large extent the work to be done under the fellowships will not involve access to restricted data, and the fellows will receive training in fields which are and will remain proper fields for unclassified work in which security clearance will not be necessary.

c) The requirement for full background investigation and security clearance would place a heavy administrative burden on the fellowship program, and such a requirement appears inadvisable except where it will genuinely serve the interests of security.

Attached for your information is a letter dated July 27, from NRC setting forth their views in this regard. In your July 30 letter you pointed out that unless an investigation is performed at the outset, it is conceivable that a person may receive a fellowship award who would not be eligible for employment in the atomic energy program. We have considered this carefully and have decided that the interests of the fellowship program as a whole will best be served by the policy we have outlined. It is our firm conviction that by pursuing this policy we will obtain more qualified fellows and achieve fuller cooperation from the scientific community of this country than would be the case if we adopted the principle of requiring security clearances at a time when it is contemplated that fellows will not have access to restricted data.

One applicant in the field of medical research, who was selected by the postdoctoral fellowship board as having

outstanding ability and awarded a fellowship, had applied to work in the Berkeley Laboratory of the University of California, where he would come in contact with restricted data. A security check developed that derogatory information existed. In this case, arrangements have been made for the individual to carry on his fellowship work at a hospital where it is believed that no possible questions of security would be involved.

It is the Commission's view that the selection procedures outlined in this letter are procedures well adapted to furthering the needs of the atomic energy program, and that they should continue to be followed, subject to such modifications as may be desirable in the light of further experience.

DAVID E. LILIENTHAL, Chairman
U. S. Atomic Energy Commission

July 27, 1948

Mr. Carroll Wilson, General Manager
Atomic Energy Commission

The fellowship boards of the National Research Council, which have assumed a large measure of responsibility for the Atomic Energy Commission-National Research Council Fellowship programs, have completed their initial selections of candidates. On the basis of this experience, one important problem has emerged concerning which we would be glad to have your advice and ruling: the policy of the Atomic Energy Commission regarding security clearance of fellows:

On the basis of my attendance at the meetings of the five fellowship boards, I would say that it is the general, and probably the unanimous hope of the members of the boards that a man should not be barred from participation in the fellowship program because he cannot be cleared. It is recognized that access to certain information which might be desired during the course of some fellow's work would require clearance, but it is felt that serious obstacles would be encountered with unfortunate consequences if the mere participation in academic study and research under these fellowships were made conditional upon security clearance.

The members of the boards realize that inability to be cleared might disqualify a fellow for subsequent employment by the Atomic Energy Commission. However, they have expressed the thought that the training of such an individual would add to our pool of scientific personnel from which the Atomic Energy Commission will draw, that is to say, a rare individual who was trained under an Atomic Energy Commission fellowship but who could not for some unforeseen reason be cleared, would be available for scientific work under some other agency or private institutions or organizations not requiring clearance and would thus free another man for AEC employment.

DETLEV W. BRONK, Chairman
National Research Council

January 12, 1949

Mr. David E. Lilienthal, Chairman
U. S. Atomic Energy Commission

By letters dated August 24 and October 11, 1948, the Joint Committee has been informed of the policy decision by the Commission not to require investigations as to the character, loyalty, and associations of applicants prior to the granting of a fellowship.

In the interim period between the establishment of the fellowship program and the setting up of this policy by the Commission, I am informed by the staff of the Joint Committee that some fellowship applicants were investigated. Since the records of these investigations are, of course, included in the Commission files, it would be presumptuous of me to call your attention in detail to the substantial derogatory information which has been disclosed upon some of the candidates who were subsequently authorized to receive government stipends. A situation now exists where public funds are being expended for the education and training of a specialist in the nuclear field who is potentially subversive and whose record surely precludes his utilization on any restricted phase of our atomic energy program.

There are other cases where the investigations revealed Communist membership or long association with potential subversive organizations to such a degree as to cast reasonable doubt and strong suspicion upon their desirability.

I realize that the decision not to require prior investigations as to the character, loyalty, and associations of these fellows is an administrative decision of the Atomic Energy Commission, but I must reiterate that in my personal opinion, when the facts are known, the expenditure of government funds for the education of a Communist is indefensible and could easily subject our atomic energy program to justified criticism.

This is a matter which I intend to call to the attention of the Joint Committee at its first session.

B. B. HICKENLOOPER, Chairman
Joint Committee on Atomic Energy

THE TESTIMONY

Mr. Lilienthal's Statement

MR. LILIENTHAL: I would like to make a brief statement of the background of the fellowship program and its purposes, and I should like to emphasize first of all that this program does not relate to the secret side of atomic energy development; that these fellows have nothing to do with atom bombs; that the purpose of the fellowship program is to uncover and to develop great and rare talents for an urgent need in the fundamental sciences, to increase the knowledge of this country in the fundamental sciences, and to emphasize that the Commission, being reluctant that the Federal Government should directly intervene in educational efforts in this country, has adopted the expedient of asking the National Research Council, a private organization with a distinguished membership to administer this fellowship program and to select the fellows, to make the awards.

In January of 1948, the Atomic Energy Commission established a fellowship program providing stipends for graduate students for study and research at universities in biology and medicine and the physical sciences. The program was established in compliance with responsibilities assigned the Commission by the Atomic Energy Act.

The work carried on under the fellowship program is overwhelmingly concerned with nonsecret areas of research in the fields of biology and medicine and in the physical sciences. In the absence of a special agency such as the proposed National Science Foundation, the Commission undertook the Fellowship Program in an effort to assist in enlarging the reservoir of trained scientific personnel in selected areas.

It is expected that some of the scientists trained through the fellowship program may be utilized in the national atomic energy program, although no commitments as to employment are made at the time of the fellowship award. Many of the fellows, however, will continue in nonsecret work outside the Commission's program where they will make substantial contributions to scientific progress.

For the administration of the program, the Commission turned to the most experienced agency for the development of scientific talent, the National Research Council. There is, we

believe, no other group so well qualified and experienced to select and develop young scientists of unusual ability and promise.

The Commission gave long and careful consideration to the question of requiring investigation and security clearance of fellows engaged in nonsecret work comparable to or parallel to that kind of investigation which the law requires and which is carried out in the case of those who have access to restricted data. The views of the Commission on this question were transmitted to the Joint Committee under date of October 11, 1948.

It was the opinion of the National Research Council that the extension of the investigative process to nonsecret study and research would seriously threaten the interests of the fellowship program as a whole and therefore of scientific progress. More than that, the introduction of security procedures into nonsecret fields, it was feared, would establish a precedent of grave and far-reaching consequence to our scientific and educational system.

The nonsecret research and training work in science carried on under this fellowship program is but a small part of the education and research now financed wholly or in part with Federal funds. Every educational institution in the country, and thousands of students and teachers, are concerned in education under the GI Bill of Rights, in nonsecret research financed by funds from the agencies of Government, including the National Military Establishment.

The proposed National Science Foundation, and the proposed program for $300 million annually in educational aid to the states, would greatly widen the range of influence of Federal funds, and therefore increases the potentialities of an error in the decision in this matter.

There would appear to be no question of national security at issue here. The sole question, it seems to us, is how best to operate a fellowship program so as to advance the scientific assets of the country. As I have indicated, it was the conviction and experience of the best qualified people in the country we could find, a conviction with which we agree, that the nation will get the most return from its investment by adhering to the procedures for the development of scientific talent tested in the past, and not by adding to these, investigations of students engaged in nonsecret studies.

The National Research Council and our staff are anxious to find an answer that will not run counter to the firmly held views of the scientific community upon which this program and other programs depend; and, at the same time, to take care not to run counter to those deeply held feelings that almost all people have about the payment of public funds to those people who avow, or are discovered to have, views completely antagonistic to those held by this Government and the Constitution.

We see no easy solution. If we can't rely on the judgment of a private, nongovernmental agency, the National Research Council, to select these fellows on the basis of ability and of their indications of great promise in the future, and without the consideration of the political and economic views of such potential fellows, we fear it would invite the danger of the Federal Government itself tying strings related to political and economic views and opinions, to educational funds. On the other side, there are the obvious objections involved in some of these particular cases, in which it is proposed on the part of the National Research Council to award fellowships to individuals who have views that at this stage in their lives certainly are completely contrary to the views of most of us, and the purposes of this Government.

Dr. A. N. Richards' Testimony

DR. RICHARDS: The question as I understand it is: Shall the young men and women who have been selected by the National Research Council to receive fellowships in the nonsecret study and research supported by Atomic Energy Commission funds be subjected to investigation as to their political beliefs or affiliations — specifically their attitude toward Communism?

Security considerations are not involved. Any AEC fellow, who is to be placed in an institution in which he would have contact with or access to secret data, must be investigated and obtain formal, official clearance. The official announcement of the fellowships contains the statement that the "research to be pursued by a Fellow should preferably be conducted with a problem which will permit unrestricted publication of results."

As I understand it, the primary purpose of the Atomic Energy Commission in financing fellowships is to recruit into new and fertile areas of investigation in the physical, medical, biological, agricultural sciences which have been opened up by developments in nuclear physics, young men and women of unusual ability and promise in large numbers. It is not the sole purpose to train young scientists to go to work in the Government-financed atomic energy programs, though it is expected that some will go into this program.

My approach to the question is influenced by the fact that the greater part of my life has been spent in teaching and research; and by the knowledge which I have thus acquired of the character and qualities of mind of just such young people as those who have been and will be selected for Atomic Energy Commission fellowship awards.

Understand that the very small fraction of our population who are eligible for these fellowships is made up of unusual individuals. Their mental qualifications have been found to be exceptionally high; commendatory references have been obtained from their professors with whom they have worked; they have become enamoured of science and are preparing to devote their lives to it. Their devotion to science implies curiosity, love of nature and desire to understand her laws, sincerity, honesty, and devotion to truth. It implies eagerness to explore new fields, to learn something which no one else at the time knows and to contribute such knowledge as they may gain to the common pool.

Suppose there is a Communist among those selected, and that he receives a fellowship. Whether or not he can be used in secret governmental projects, his training will have added one more to the group—now far too small—of those capable of utilizing knowledge of nuclear energy and of its products in the advancement of medicine, biology, agriculture, and, at need, could release for government-classified service another who possessed no disqualifications. The country will have been the gainer by his training. That is point No. 1.

Next, I hope you will consider what the effect upon future applicants will be, if a rule be made that each successful applicant shall be subjected to an investigation of his political and social views. If not generally known now, it would soon become generally known that the information collected about an individual in such an investigation is not limited to provable facts, but, of necessity, includes hearsay accounts of associations, of the opinions or suspicions of neighbors or companions, possibly colored by personal prejudices. Knowledge that successful applicants were to be subjected to FBI investigation would, I believe, act to deter sen-

sitive young people, some of them desirable, from applying.

The FBI does not, as I understand it, pronounce a judgment; it simply provides data. The decision would have to be made by the Atomic Energy Commission. The National Research Council, not being a government agency, ought not to be empowered to make such a decision, and, if empowered, should refuse to accept the responsibility as not being within its competence.

The effect of a disqualification by AEC of a successful applicant on political grounds, would be a stigma—a wound—which would be apt never completely to heal—and it would be given at an age at which it could well produce the greatest degree of damage. It is intolerable to me to think that in order to assure our taxpayers that their money is not being spent in the training of Communists, we must subject a most precious part of our intellectual resources to the risk of hurt involved in such investigation, where no question of security is involved.

If saving of taxpayers' money is an issue, a balance should be drawn between the cost of conducting FBI investigations of the hundreds of successful applicants and the cost of the fellowships for the one or two per hundred who might be disqualified. Is it wise to spend thousands in an effort to avoid an expenditure of hundreds—particularly when one cannot be sure that the expenditure of the hundreds would not be a good investment?

I have referred to the age of the group whose fortunes are being considered. It is made up of individuals at the beginning of professional careers devoted to the quest for truth. Must we not assume that that ideal will be their guide in social relations as well as scientific? They are not mature, and if our social and political system is as worthwhile as we believe it to be, can we not assume that it will so prove itself to them, as their experience broadens?

A third point, the most important that I have to present, seems to me to be this. If it is ruled that the Atomic Energy Commission fellowships cannot be granted to any except those who have successfully passed an examination of their economic and social views, a first step will have been taken toward a disastrous intervention of Government in education. The press last week reported that one of the members of this committee expressed the view that if a National Science Foundation is created, he would advocate that an investigation should be conducted of the social and economic views of every applicant for a scholarship or fellowship granted by it. I believe, with all due respect to the patriotic impulse which animated the Senator, that such action would be a blow to the principles of freedom of thought on which this country was founded. It would introduce an element of educational procedure so closely akin to those by which the Russian bureaucracy controls science in that country as to be scarcely distinguishable from them.

The education and training of the young people of this country is the heaviest responsibility which the older generations of us carry. Damage to a single unit of it is damage to the country; damage to such a specially qualified group as that of which we are speaking would, I think, be irretrievable.

SENATOR HICKENLOOPER: Mr. Freistadt has had a history of Communistic activities, allegedly, at least, in two universities. He has now been awarded a fellowship which carries with it some $1600 a year of public money to pursue his education.

I think it is fair to ask you, in view of your statement: Do you believe that that fellowship should be continued, or discontinued?

DR. RICHARDS: In preparing myself to answer that question, I would like to find out from that man himself, what is going on within him. He signed an oath of allegiance when he joined up, in 1944. Is he so committed to the principles of the Communist Party that he has forgotten that oath and the obligations which it entails? He is false to one or the other. If he is false to this Government, he ought not to get it.

SENATOR HICKENLOOPER: I presume that it is well nigh impossible to test the secret workings of a man's mind. We have to go on whatever information and evidence can be picked up surrounding the situation. The latest evidence, according to the newspapers, that we have on this man is that within the last few days he has again reaffirmed that he is a Communist.

If we believe what we see in the Communist principles as they have been recited and laid down in this country, to the public, they have as one of their principles allegiance to Communism, international, and not allegiance to any particular government or country, unless it be to Soviet Russia.

Then we also know, if we can believe the tremendous volume of evidence that has been developed, that it is a part of the fundamental Communist philosophy to use falsification, deception, and any other means at hand to gain their ends, even to the denial that they are Communists.

DR. RICHARDS: If I were possessed of the convictions which I believe you hold, I would say that he ought not to have that fellowship.

SENATOR HICKENLOOPER: But, Doctor, what convictions?

DR. RICHARDS: The convictions that Freistadt is an active Communist, and that he accepts the principles of the Moscow Politburo. If he is committed to the principles and practice of Communism, then he is false to his oath. He is a dishonest person, and he shouldn't have any fellowships of any sort.

SENATOR HICKENLOOPER: Why do you believe it is any more offensive to investigate these people who are going on the payroll in this educational field than it is to investigate the backgrounds of people becoming United States Attorneys General or Federal Judges?

DR. RICHARDS: I think you are dealing with two orders of people. People who are entering Federal employment are not, in my opinion, in the same category as people who are receiving a fellowship.

SENATOR HICKENLOOPER: Is that not the issue: whether or not public money is being spent to educate subversive people?

DR. RICHARDS: It seems to me that the greatest issue is the advance of scientific competence in this country capable of providing us, should another emergency arise, with the people on whom we can rely to help us out as scientists helped us out in the last war.

I have had numbers of FBI investigators come to me and ask me for my knowledge and my opinion about this, that, and the other person, and I am assuming that it all goes into the folder. And there is fact and hearsay mixed up, on which some agency has to pass. Now, there are sensitive people who don't like that, who don't like to subject themselves to that sort of thing.

SENATOR HICKENLOOPER: Dr. Warren stated that there have been but three or four cases where substantial suspicion or criticism could be raised. Would the elimination of those three or four from the entire program wreck the fellowship program, do you believe?

DR. RICHARDS: The mere elimination would not wreck it. The system which provided the elimination might damage it badly.

I have ventured to suggest to my friends, here, near me, that one simple thing might be done: that after a man has passed the scrutiny of the National Research Council Committee, and it is planned that he shall have the award of a fellowship, that he should be asked to sign an oath of allegiance. That puts him on record with an oath which is utterly contrary to the Communistic principles and practice. If he is false to that oath, get rid of him.

SENATOR KNOWLAND: Would you see any objection, in the questionnaire to asking the question, "Are you now or have you ever been a member of the Communist Party?"

DR. RICHARDS: I think I see objections to that. The fundamental point, it seems to me, is including political faith as a criterion for educational opportunities.

SENATOR KNOWLAND: You treat the question of membership in the Communist Party as though it were a simple political question as to whether you belonged to the Democratic or Republican Parties, or the Socialist Party or the Progressive Party. You apparently do not feel that the Communist Party is, in effect, an international conspiracy.

DR. RICHARDS: Young people, particularly young people of an inquiring trend of mind, may go all out and be professed and active Communists. I regard them as immature and capable of revising their beliefs. To make it all black or all white seems to me to make the question too simple, far too simple.

SENATOR KNOWLAND: I also would like to ask of Mr. Lilienthal: whether, in the case of a known Communist, you feel that a fellowship should be available to him on the same basis as any other applicant.

MR. LILIENTHAL: My answer, Senator Knowland, is to refer to the relation that we have established with the National Research Council. I would assume that we should ask them about the effect upon the fellowship program of the application to it of the investigative process. They say that to impose that kind of standard is the wrong way to handle it from the point of view of scientific progress.

SENATOR KNOWLAND: I am dealing specifically with funds appropriated by the Congress to the Atomic Energy Commission, which you are responsible to the Congress for expending. And if you delegate any of your power, you are delegating it with the ultimate responsibility still in your hands to the Congress of the United States.

MR. LILIENTHAL: It is true, and you are quite right, that the responsibility is ours. If they have made a decision, if they have made a recommendation, to award a fellowship which is wrong, we are responsible for having followed their judgment. But I would a lot more happily carry that responsibility than to feel ten years from now that I had been a party to a very terrible turn of the road in the relations between the Government and education. I think the Government should keep its fingers out of education, and I think this is one of the ways to do it in the atomic energy program. And when the day comes when the Federal Government selects individuals for educational fellowships, that I think will be a sad day for this country. Because with what is going on in the development of additional funds for education, this $300 million program is just the beginning, and everybody here knows it. And the kinds of tests that will be applied by the Government as to who shall and shall not receive the benefits of educational funds, in the high schools and the colleges, and even in the grade schools ten years from now will make our hair stand on end. That is why I think it is a terribly serious case.

SENATOR KNOWLAND: Do you not think there is a difference between a situation in which these fellowships are being granted by the Atomic Energy Commission in the field of nuclear science, and a general education program?

MR. LILIENTHAL: Senator, it seems to me a line has been drawn in this law. The line has been drawn essentially between those individuals who have access to restricted data and those who are engaged in nonsecret work. That is contrary to the general traditions of the country, but necessity dictated it. And it is a line that can be fairly well followed.

But when we get out of the secret work, it seems to me, then, while we may find some other line, I myself have not seen it. I find it very difficult to find any other line since we are in nonsecret work.

SENATOR HICKENLOOPER: Mr. Lilienthal, I think you have just announced a rather startling departure from normal government operations, when you say that you turn over the ultimate decision of a governmental function to a private body.

MR. LILIENTHAL: Well, I don't shy away from that. I don't shy away at all from that, where the field of education is involved.

SENATOR HICKENLOOPER: I feel we are not justified in having the Secretary of Defense select an advisory committee of private citizens and letting them make the decisions which he will accept on the programs of our national defense. He may receive advice. But to abrogate the responsibility of a public body, especially one that has such vast authority as the Atomic Energy Commission, to a private group which is in no way responsible to the Congress or to the public, except as private citizens, is rather a departure.

MR. LILIENTHAL: I can only say that I have so deep a distrust of political domination of education that I think that whatever the theoretical objections—and they are considerable—that is a far preferable course.

REPRESENTATIVE ELSTON: Let us bear in mind all the statements that Freistadt has made during the past few days, which indicate clearly that he is a Communist and does not intend to change his position. If, notwithstanding that fact, the National Research Council recommends that he be continued as a student, what are you going to do about it?

MR. LILIENTHAL: It seems to me we would only have two choices. If they say, "We believe an important principle in the field of science and the freedom of education is involved, when a political or economic test is imposed

in respect to otherwise worthy and promising individuals, and we stand on that," then it seems to me we have only two alternatives. One is to accept that, and the other is to accept the resignation of the National Research Council.

REPRESENTATIVE ELSTON: Are you going to keep Freistadt, a Communist, in this program if the National Research Council recommends that he be kept?

MR. LILIENTHAL: I would feel obliged to accept the judgment of the Council.

REPRESENTATIVE ELSTON: Even though you knew he was a Communist?

MR. LILIENTHAL: Even though they knew he was a Communist.

REPRESENTATIVE ELSTON: Your whole theory in educating these students at the taxpayers' expense is that they might be useful to the Atomic Energy Commission?

MR. LILIENTHAL: No, I think it is a great deal broader than that, Mr. Elston.

REPRESENTATIVE ELSTON: A boy who is a Communist certainly could not ever be of value to the Atomic Energy Commission.

MR. LILIENTHAL: Yes, but it would be pointed out to me—and this will be of especial interest to everyone who is worried about the prospect of cancer in his family, or as to himself in the next ten years—that this might be the mind that would break the last barrier to the solution to the problem of cancer. There are many instances in which people of unworthy political beliefs have the kind of genius that the country needs in nonsecret aspects of development. And although I realize that the categorical answers here represent quite an unpopular and to me a distasteful alternative, I think the alternative in respect to the damage to science and free education would be even greater, and we will all realize this, not today or tomorrow but some years later.

REPRESENTATIVE ELSTON: You do not think we can find that genius among 100-per-cent-loyal American boys?

MR. LILIENTHAL: One never knows where genius is, Mr. Elston.

REPRESENTATIVE KILDAY: Mr. Lilienthal, why do you assume that if you should not continue the fellowships in this instance, or if you should not award the fellowships in accordance with the recommendations of the National Research Council, you would lose their services?

MR. LILIENTHAL: I didn't, Mr. Kilday. I was asked a hypothetical question, and I indicated that if they regarded the issue that strongly, then it seemed to me that in that kind of a—

REPRESENTATIVE KILDAY: You had no indication that they would do so?

MR. LILIENTHAL: No.

REPRESENTATIVE KILDAY: Doctor, is your organization that temperamental?

DR. RICHARDS: It is not.

REPRESENTATIVE KILDAY: So we cannot assume that you would withdraw?

DR. RICHARDS: No.

REPRESENTATIVE KILDAY: Then what are you going to do with Freistadt if it develops that he is a Communist, Mr. Lilienthal?

MR. LILIENTHAL: I think what ought to be done with this case and other cases is to ask the National Research Council to study the procedures they have been following, the kind of questions they have been asking, in the light of this case, and see whether they themselves would not come up with suggestions which would produce a much more satisfactory result.

REPRESENTATIVE KILDAY: Would the Council be willing to pass upon the man's technical qualifications and submit them to the Commission for its final determination as to whether other factors might make him unacceptable for the Government program?

DR. RICHARDS: If the Atomic Energy Commission asked us to do that, certainly we would.

THE CHAIRMAN: Dr. Richards says that in this Freistadt case, which has more or less precipitated the discussion of this issue, in his personal opinion, they made a mistake. If that is their opinion, then it seems to me that a good deal of difficulty is obviated.

MR. LILIENTHAL: That is correct, Senator. I think, however, there is a danger in missing the question, which is not concerned with this individual case. Is there some way of avoiding becoming involved in the process of making selections in the cases of men doing nonsecret work with the same considerations that we go into in the case of men doing secret work? That would include opinions and affiliations, including affiliations with or membership in the Communist Party. The reason I say that is that I do not think that it would be any time at all until we will be faced with the fact that it is not these avowed Communists who are a problem. It is these more devious fellows who do not profess Communism, but are actually affiliated secretly. That is the real trouble.

What troubles me is that the Congress of the United States has thus far not drawn the kind of line that would make this an easy case. The Congress of the United States, for reasons that seemed to it wise, has decided not to outlaw the Communist Party, not to say that a Communist is not like a Republican or a Democrat, as you have said; not to say by law, "The membership in or affiliation with this organization is, in effect, illegal and a crime against the country." That would be an objective approach, but it has not been done. It would assist the drawing of this line.

SENATOR HICKENLOOPER: Yes, but I would like to suggest that the United States Government has said that Communists will not be carried on the public payrolls, will not be supported by public funds.

REPRESENTATIVE DURHAM: Mr. Lilienthal, I believe Dr. Richards has suggested, in connection with future examinations, the use of the loyalty oath. Would you accept a loyalty oath?

MR. LILIENTHAL: I would accept not only a loyalty oath, but any other improvement in the procedure of the National Research Council, which they believe would be in the interest of the purposes discussed here, and would not discourage scientific development.

SENATOR HICKENLOOPER: I did not have the conception of the fellowship program that it was to be education in the broad fields of science, rather usurping some other fields of national education that we had talked about. I had the idea that the fellowship program was in a restricted field of nuclear science for the benefit of the Atomic Energy Program.

I would like to ask, Dr. Richards: Would you see any harm if the Atomic Energy Commission would say to your group, "We want to educate a certain number of brilliant young people, scientists, but we have certain qualifications that we would like to lay down in advance. Number 1, they must, within your judgment, be able and capable of doing a job. Number 2, they must be of good moral character; we want no immoral people, if we can help it,

in the program. Number 3, they must not be people who are subversive or reasonably potentially subversive people, so far as the Government of the United States is concerned. We would like for your group to operate within that program. Do you think you could do it?"

DR. RICHARDS: The National Research Council Committee might well say, "We are not equipped to discover potential Communistic tendencies."

Dr. Detlev W. Bronk's Testimony

THE CHAIRMAN: We are now aware that a certain young gentleman in North Carolina who has been awarded one of these fellowships is one who is very much dedicated to Communism. Doctor, it was a rather unfortunate thing that he got into this program, was it not?

DR. BRONK: It certainly has made a lot of complications.

THE CHAIRMAN: How are we going to prevent that from happening again?

DR. BRONK: In the past we have operated primarily in the field of postdoctoral fellowships. Individuals who have already received their doctorate have been in close association with the professor under whom they have been doing their research, so that we have had a very good source of information, concerning their general qualifications, character, personality, physical stamina, and all of the other elements which contribute to their effectiveness as well as their mental capacity.

When, during the latter part of the war we began a program of fellowships under a grant from the Rockefeller Foundation to young men who had been in war service and had had their scientific training interrupted, we became cognizant of the fact that it was much more difficult to identify the people who were to be awarded fellowships. In that particular program we had some 2,300 applicants, and we were able to make approximately 190 awards.

It was apparent to us that we were facing new problems in the selection of people; that is one of the reasons why there has been appointed a committee on the identification of scientific personnel, under the chairmanship of Dr. Rulon at Harvard. That leads me to say that I think we should have a means whereby we can find more information regarding the general characteristics of an individual. It would be desirable if we had, in addition to the statements from three scientists who know the candidate, a statement by, I would say, the Dean of Men, who would have a different sort of basis of appraisal of the character of the individual. Or if the Dean of Men felt unable to give us a statement concerning the personality and character of the individual, it could be suggested that he designate someone who could give to our board such information.

Now, that will be my personal recommendation to fellowship boards. But I would like to say that we believe that our best chance of securing a fair appraisal, a good appraisal, of an individual's qualifications, is to be gained from individuals who know him in the local institution in which he works.

I firmly believe that, except in rare instances, when we take into confidence our fellow citizens, we will get good advice.

I don't believe, and I am sure you would agree, that we can be absolutely certain that we can avoid every single instance. I think the individuals who are most dangerous, as I would say, based on my long association with military agencies, are the ones who are best able to hide the sort of thing that Freistadt did not hide. How one is going to find those, I do not know. I think we could hedge ourselves around so completely by defenses against individuals who might be dangerous that we could not make any progress at all, and would be unable to move.

So I think, as I say, that we have got to take some calculated risks. That is not to say that we shouldn't do what we can to improve our system of finding those individuals who are most able to make important scientific contributions.

THE CHAIRMAN: At least, I certainly agree that more care should be taken and that more investigation should be made. Now the question comes of "Who should make the investigation?" I presume. But at least we are agreed on the fact that we should not be required to educate a fellow like this Freistadt.

DR. BRONK: But I am confused on that, sir, because I find that the G. I. Bill of Rights was providing him money for education, and I personally can't see any difference between providing money under this fellowship program and under the G. I. Bill of Rights. It seems to me that he is as dangerous under one category of support as under another.

SENATOR HICKENLOOPER: Under the theory of the G. I. Bill of Rights, educational opportunities are considered to be an earned matter of right, which has already been earned and paid for. Under the fellowship program it is a matter of governmental grace. It is extending a gratuity that is not considered to be an earned award. I think there is a fundamental difference.

DR. BRONK: I see the distinction.

REPRESENTATIVE DURHAM: It appears that Freistadt was interviewed, and he wrote this letter to the *Tarheel:* "I criticize our present Administration as an economic organization. I have urged that under Socialism the American people could enjoy a standard of living the like of which we dare not dream of now. The right to so argue is a privilege that every citizen enjoys, and it requires a highly distorted reasoning to make disloyalty out of that. I consider myself a loyal citizen of this country. I am bound by my oath of citizenship to defend it against any aggressor, and will do so if necessary. I see no contradiction between my loyalty and my membership in the Communist Party. I consider allegations that the Communist Party is under foreign control lies, and until such time as these allegations are proved in court I will judge the Communist Party by its published platform and constitution, to which I subscribe."

If you had known that, certainly you would not have selected him for a scholarship, would you?

DR. BRONK: I would say it indicates a person who doesn't think very clearly and is not likely to be a very good scientist.

I am afraid I would have to say, if I were going to be absolutely frank, that I am not a very good witness in such a hearing as this, because I have certain prejudices, very deep and strong and almost violent prejudices, in regard to this whole matter; which do not make me a very good scientist, when I come to talk about them. I do wonder whether we don't encounter some young chaps who do have a great capacity to make an important contribution to our national welfare, who are experimenting with new ideas, not only in the field of science, but also

in the field of social philosophy. And if they have the capacity to become really able scientists, I would have the faith—or I would have the hope, that as they develop a little more maturity, they would recognize the fallacy of their point of view and would soon cast it overboard.

So I think we have to take into consideration what the calculated risk is that we can take in letting an occasional person of this sort come into the program in the hope that he will become wiser as he develops. I don't mean to say that he will become wiser politically because he develops more scientific competence, but as he develops scientific competence he is also going to develop the maturity in his social outlook which is going to make him not only a useful scientist but a respectable citizen of the country.

SENATOR HICKENLOOPER: Would you think that the National Research Council would be offended if the Atomic Energy Commission said to it: "We do not want immoral people and we do not want subversives in this program, but we will assume responsibility for the examination into those phases. What we would like your help on is the recommendation of capable people, and we hope you will not be offended if somebody you recommend is found by us to be not the type of individual morally, or from the standpoint of loyalty or otherwise, that we would like in this program"?

DR. BRONK: I certainly don't think they might be offended. They might find it difficult to operate if the procedure were going to be carried out in a certain way.

I took the time to sit with each of the boards and hear their discussion. And on the basis of those discussions, I wrote to the Atomic Energy Commission that it would be very difficult to operate the program if each applicant were to be investigated by the Federal Bureau of Investigation before the Fellowship Board was to go into action. I also had very strongly the impression that the members of the boards felt that that would be an unwise thing to do. Because, if I can interpret their feeling correctly, it was that if they did not take that stand they would be encouraging a line of procedure which might have very far-reaching implications in the whole field of education. They were thinking in terms of the proposed National Science Foundation.

I believe I interpret their opinion correctly when I say that they felt

that they did not want to be party to any recommendation which would imply that no individual should be supported without FBI clearance. I now exclude the G. I. Bill of Rights, because I have been corrected on that and see the case quite clearly. But they did not want to be a party to endorsing any procedure which would involve Federal Bureau of Investigation clearance benefit for scientific education.

SENATOR HICKENLOOPER: I do not believe the American public will stand for the education of a Communist with public money.

DR. BRONK: So the same thing would be true of the National Science Foundation?

SENATOR HICKENLOOPER: I believe that really is the issue. It is the question of whether or not we are going to say that we will use public money to educate people who believe in Communism.

DR. BRONK: What I would like to see done is the working out of a means for selection which would meet the needs of the situation without having to go all the way down the road in the investigation of every person to whom we are going to give Federal support for education, possibly under the National Science Foundation or some other agency. We ought to be sure we are not taking a step which is finally going to put us too much under a type of control that we would all regret.

I wonder whether the requirements that they take an oath of loyalty would satisfy the needs of the situation, coupled with this much greater scrutiny which I will strongly recommend with regard to getting from individuals other than those merely qualified to judge their intellectual competence, some appraisal of the character and personality of the individuals concerned.

REPRESENTATIVE KILDAY: Doctor, basically, what you fear is an infringement on academic freedom, is it not?

DR. BRONK: Yes, I am not quite sure that I know what academic freedom means, but I think we have a vague feeling about it. That is certainly part of it.

REPRESENTATIVE KILDAY: Of course, it is a very well-established principle in the field of education that there shall be academic freedom on the part of the professor. But do you not think there is a distinction here, when a man applies for and receives public money? When a person accepts public money, he assumes a different status, and it is not an infringement of academic freedom to affirm that. You are to evaluate the academic and scientific potential of the individual. But it would not at all infringe upon academic freedom for you to say "Well, now, here is an individual who has an outstanding potential in his field," and then leave it to someone else to say whether he should receive the fellowship.

DR. BRONK: I think it would depend on what it would do to the value of the program as a whole. And what I have in mind is that if the type of added criteria to be placed on these individuals was such as to reduce the contribution to the scientific advancement of the future which the National Research Council desires to achieve, or such as seriously to impair it, then it might be that the members of the board would feel that they would not be making a sufficient contribution to be worth the serious difficulties which they brought into the program.

REPRESENTATIVE ELSTON: Do you think now, Doctor, as a citizen that the Atomic Energy Commission should be spending the taxpayers' money to educate a boy in scientific subjects unless the Commission can use the boy after he gets through with his course of study?

DR. BRONK: I would like to stress as strongly as I can that I don't think that these fellowship boards had the slightest desire to encourage anything of a subversive nature. As for the things that they would have been concerned about, take, for instance, this matter of association. If I were responsible for a highly classified project, I would not want to have certain people associated with that project who, on the other hand, I might be quite happy to have participate in the teaching functions of the university. The reason why he might not be satisfactory for work on this highly classified project could be because of lack

of discretion, associated with people who might have inadvertantly succeeded in getting from him certain types of information which he had not intended to disclose. We all know that there are such people who are not sufficiently judicious in their associations, to be known as highly reliable individuals. But that same person might be extremely loyal by every criterion except his judgment as to whom he associated with. And I would think that the boards would feel very hesitant about saying that such an individual should not be trained scientifically, because as he got older he would develop more judgment as to whom he should associate with and what he said under circumstances where he might be surrounded by people who are not entirely competent.

REPRESENTATIVE ELSTON: You are not dealing with high school students here, you are dealing with boys in college, and Freistadt was twenty-four years of age. I do not think that you can go along on the assumption that they will change their spots after a time.

If they are Communists, the probabilities are that they are going to remain Communists, and they are going to remain loyal to Russia and not to the United States.

THE CHAIRMAN: Of course, Louis Budenz did not.

REPRESENTATIVE ELSTON: Well, there are exceptions, of course. But we should not spend the taxpayers' money to develop the exceptions, and that is what this program would do and what this policy would do.

THE CHAIRMAN: Might I fairly summarize your testimony by saying that you are of the opinion, in this particular case that is now under consideration, where a poor choice is made, that some technique should be worked out to avoid a repetition of this unfortunate situation?

You, however, do shy away from the customary Federal Bureau of Investigation investigation of these people, and you would prefer, if you had your own preference, to conduct a more detailed and more careful scrutiny of the applicants yourself. Is that your attitude?

DR. BRONK: That is correct, sir, with one amendment. I would hesitate to say that this is a poor selection until I had had a chance to discuss the matter with the Board and let them present any evidence which I do not have available, which would support their choice.

SENATOR HICKENLOOPER: Then we get back to the suggestion I made awhile ago that certainly it should not be offensive if the National Research Council stuck to its strong field, which is the evaluation of capacity and potential, leaving to some other group the responsibility of saying whether in other very vital areas, this student measures up to a desirable goal or a desirable standard.

DR. BRONK: I think you would find, sir, that the scientists of the country generally would feel that they also had something to contribute in the matter of advice, as to the effect of political philosophies as to whether or not a person can do useful scientific work. I think they would feel that they would have some competence to appraise the matter of how far such beliefs would affect their scientific ability generally. I think that perhaps they would have some competence to assess what are going to be the ultimate implications of this type of background and attitude which should certainly be supplemented by other attitudes.

SENATOR KNOWLAND: From the purely scientific point of view, I would suppose that Dr. Curie in France may be the equal or superior of any person who could be selected to set up the atomic energy program of that country. Yet I do not think your Board would suggest that in furtherance of the pure scientific point of view we should ignore other factors.

DR. BRONK: There is available a large amount of information which we would not and could not under the law make available to a person of such political beliefs as those of Curie. But as to whether or not, if Curie were a young man just about to begin on a scientific career, it would be wise to bring him into the program, or deny him the education which would make him the sort of scientist that he is today, well, that is a broad question, but it is a question which will increasingly face us, I think in this country. I wouldn't be wise enough to have the answer myself.

[2] See page 163 of this issue.

SENATOR HICKENLOOPER: Of course, under our system, Doctor, he is not denied an education. Education is not denied to a Communist in this country. It is the question of the use of government funds to support that education.

THE CHAIRMAN: A very distinguished American, Dr. Robert Oppenheimer, has addressed a letter to me bearing upon the subject which we are discussing which I think it would be well to have read for the record.[2]

Dr. Alan Gregg's Statement

DR. GREGG: I think that it is a very inadequate statement of what happens when a man is given a fellowship to say that he is *given* a fellowship. I think it is inaccurate because the real job of any organization that runs fellowships is to find ability and they are darned lucky if they can find it.

I want to point out that this condescension on the part of Government to give these young men an opportunity is seriously inaccurate and almost to the point of being quite a false view of the situation. We are looking for brains and we are looking for character and, when we can find them, it is as good as a good business deal with both sides profiting. I bring that out because if you are looking for something and it is not a buyer's market but it is a seller's market, in other words, if you are looking for exceptionally good brains and they do not grow on every bush, you have to consider the circumstances that influence the hunt, and, if you throw out certain conditions that diminish the likelihood of finding able young men for any reason whatsoever, you have narrowed your market; you have reduced your chances; and you have failed in your special obligation to find men of ability.

I would not care to open a fellowship program under circumstances that would dissuade a seriously large number of applicants from applying. I would not open with a note of distrust for the simple reason that young men who have their careers to make are pretty concerned about it and if they suspect something that they do not like and can go elsewhere, and thereby avoid it, you will not have them nibbling at it, and you will not have a chance to get them. They would go to university positions that do not lay down peculiar requirements or they would go into some other call-

ing that does not call for something that is radically distasteful. When you put down an FBI investigation or special security investigation at the beginning of a fellowship as a *sine qua non*, I am convinced that you will cut yourselves off from a good many candidates who will say, "Thank you very much. Don't want to go into that atmosphere anyhow."

You can say, let us forget about them. I am not so sure that you can forget about them and for this reason: I have heard the phrase today "potentially subversive." The great characteristic about youth is that it is potentially everything. If you are going to use the phrase "potentially subversive," you have to realize that the Government's attitude in giving scholarships and fellowships is one of the things that is involved in changing that potentiality into a reality because there are plenty of people, young ones particularly, who will revolt at that kind of interference. You know, sir, as well as I do, that young men are somewhat restive about authority; that is a characteristic of the young men.

On my last visit to Europe this time a year ago, I wasn't impressed by the number of Communists in Europe but what puzzled me and interested me was, what are factors that convert a man who is on the fence to going over to the Communist side? What are some of the factors? Those factors are disillusionment, cynicism, their dispossession, lack of hope, and their youth, because youth has not engaged itself in the long-term undertakings that require stability, and you always have potentialities in youth.

I think that it might be useful for me to go a little more into the details of the kind of effect that comes to a group of young men who may consider themselves for or be asked to consider themselves as candidates for fellowships when among the requirements there comes a request for information on political beliefs. Almost inescapably I think the reaction is, "Oh, this is a political job. What I think about government is apparently going to have something to do with how good I am as a physicist. They haven't any business asking me about that and whether or not I am a member of the Communist Party. If that is what is injected, in here, that is a foretaste of what the conditions of work will be."

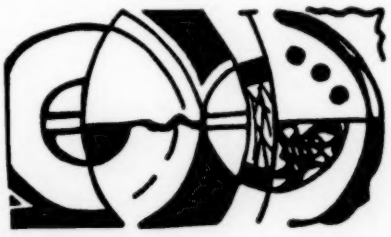
There are those who will say that that is not what we thought America stood for and they will become, by that mere maneuver, pretty impassionate or dissident against that particular qualification.

In order to study, we will say, the effect of radiation on plant cells the candidate first has to start off by saying what his political convictions are and what may have been his earlier affiliations. We all know that human beings are somewhat governed by emotions at times and this is a sort of tentative thing for the man and he says, "This is a foretaste, and now what are the other strings attached to it?" And there are other alternatives, and he does not go on with it.

I had an amusing illustration even at my age. I would suppose that my potentialities are now rather limited, but I served for five meetings on the United States Public Health Service Advisory Committee on mental hygiene for nothing. I gave up Saturdays and Sundays and I did not take any honorarium, and after that I put "record of distinguished service," discommoding myself to that extent when I could have had some per diems.

Then I got a rather curious letter from the Public Health Service saying to please have my fingerprints made and send them back promptly. Also, please tell them under what other names than my own name, I had ever been known by. As a matter of fact, when I was in college I had such a red face that I was known as "Pinky," so that is obviously one thing against me. Then my wife refers to me as "The Boy Traveler." So, I have two strikes there, and what do I think of an organization that does that? I think it is ludicrous.

Now the Federal Government sets up a move of this kind, sets up a remarkable state of affairs for all those who believe that the Federal Government should never touch education. I do not see, if the Federal Government takes the position that it has to have an oath of this kind or investigation of this kind on federally supported fellowships, where that particular move stops. How about the state universities? Are you going to give any money to state universities that do not follow this? How about your high schools? How about your teachers? Are you going to run a general witch hunt in this direction? I do not see what the limit may be to it.



REPRESENTATIVE HOLIFIELD: I am inclined to think we have to consider that the main purpose of the research of the Atomic Energy Commission is for the purpose of developing scientists in this particular line of nuclear science. We are not interested in general science. I am inclined to think that some of your ideas along the line of general science are probably correct, but here we are operating in a restricted field, and are we justified in going out and taking people into this field and spending the Government's money under this Act, taking a chance that the money that is spent to produce scientists in this area will later on be nullified because we will have to screen them out?

DR. GREGG: You may not like the analogy, but supposing you give a dinner party or dance and down at the bottom you put R.S.V.P., which means, please tell me whether you are coming or not, and you also add "Please accompany this with a Wasserman test." You can say that you do not want people at your house that might contaminate your guests. What is the general flavor of that invitation? We would probably have a considerable reduction in tragedies of various kinds if people always accompanied their invitations with things like that, but, in the long run, it is not the right way to get guests to the party. If it comes to a question of actually marrying your niece that does come in quite sensibly, but you do not screen people that way in the beginning. I think it is foolish to screen them this way in the beginning because the connotation of the screen put first of all is one that handicaps your choice of persons to serve.

REPRESENTATIVE HINSHAW: We require an oath on the part of anyone who is commissioned in the service of the Government, the Army, Navy, and Air Force, and they have no objection to taking that oath of office and declaring their loyalty to this country.

DR. GREGG: That is right, and there are a lot of people that stay out of those forces. My point is that it is not the number of existing Communists that makes that much difference. It is what you do that turns these young people either in favor of the Government or against the Government and

on that basis I do not believe that it is smart to push, as a qualification for a job which has nothing to do with political life, a political issue.

REPRESENTATIVE HINSHAW: This is not a political issue; it is a loyalty issue.

DR. GREGG: Call it a loyalty issue.

REPRESENTATIVE HOLIFIELD: We extend an appointment to these boys that go to Annapolis and West Point, and those boys go in with an obligation to the Government to spend at least five years in the service of their country. Do you think it is degrading that they should have to comply with a qualification, both of loyalty to their country, oath of loyalty, and of service, minimum service of five years, in payment, you might say or in gratitude, or whatever term you wish to use?

DR. GREGG: Not in the least. They know exactly what they are getting into, but that does not mean that you have the choice of all of the bright young men in the United States to go to West Point and Annapolis. In the medical schools at the present time I venture to say that they have more applicants than they do for West Point and Annapolis. Yale has 1,465 applications for 65 openings this next year. If you can match that at either Annapolis or West Point, I will be surprised.

I say you have a duty to get your hands on the best brains that you can find, and not to handicap yourselves by an initial screening which has nothing to do with really serious information that might be imparted, and that is restricted information. I beg you not to do it, but, Gosh, you can do it, there is nothing to stand in your way of doing it except that you have a price tag on it. You have a price tag that I think will have some bounces that will not be agreeable to you.

REPRESENTATIVE DURHAM: On that point, what do you base your opinion on? Have you made a survey?

DR. GREGG: I base my opinion on the sensitive frame of mind that a young man is in when he tries to go forward with the only capital he has, which is his mind. If he finds circumstances where he is given a great deal of freedom it appeals to him and frankly, we, in the [Rockefeller] Foundation, find that the fellows prefer freedom in the Foundation fellowships, over some opportunities, because we give them freedom. We say that "it is up to you to choose the person you are going to work with; that you can take counsel with your teacher; you can take counsel with us; but the thing is for you to do, not us." That element of freedom appeals tremendously to young men. We do not put any foolish screen at the beginning of looking for candidates. You have to cast a net very far and very free to pick up real ability, and you have to give them circumstances that appeal to them. You gentlemen may or may not know it, but the actual restrictions on research work in this field are such as to constitute a handicap in and of itself to a scientific man because he has been brought up all his life to believe that what he can find can be shared, and, by Gosh, here is a service where you just cannot do that and I want you to realize that you are in a difficult position in terms of reaching ability.

Gosh, I have seen so many young men turn from radicals to conservatives and so few turn from conservatives to radicals that I do not worry about the passage of time if they are busy with physics in the meantime. I know there will be examples that will be shocking, and terrifying, and all that, but, darn it, they do not amount to as big a price as you pay if you go into this fear-stricken attitude.

Statement by The American Institute of Physics

At a meeting held on May 27, Messrs. George R. Harrison, Paul E. Klopsteg, F. W. Loomis, George B. Pegram, and Wallace Waterfall, members of the Executive Committee of the American Institute of Physics, addressed the following telegram to Senator Brien McMahon.

As members of the Executive Committee of the American Institute of Physics, and in response to a spontaneous demand from many outstanding physicists, we wish to express grave concern regarding the effect on the atomic energy program of the misleading impression on the public which appears likely to result from recent congressional criticisms of the Atomic Energy Commission. Criticism of the AEC has recently appeared on two points: namely, possible laxness of the Commission as to security, and the question of clearance for holders of AEC fellowships.

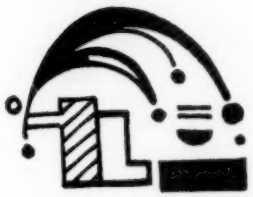
As to the first of these, the instances claimed by some to show that the Atomic Energy Comimssion may be lax in security measures do not impress us as serious, especially when considered in comparison with the magnitude of the Atomic Energy Commission program. We are, however, convinced that grave danger is threatened by some of the measures that are being advocated as a result of these criticisms.

The atomic energy program is a scientific and technical enterprise, the success of which depends essentially on the quality of the personnel that can be attracted to it. By direct personal observation we have been greatly impressed with the improvement in morale at atomic energy laboratories that has been effected by the Commission. Hasty disturbances of the Commission, its policies, and program, will inevitably jeopardize this morale with consequent ill effects on the program.

As to the Atomic Energy Commission fellowship program, we believe it is well conceived for the building up of the scientific strength of the country. The requirement of the loyalty pledge and non-Communistic affidavit for AEC fellows is reasonable, but security clearance would be an unnecessary extension to the field of education of measures appropriate only in secret work.

A clear distinction should be drawn between the need for investigation of a scientist who is to work on secret matters, and a fellowship-holder who has no access to such matters without undergoing the same personal investigation process and clearance as is required of an AEC employee. The FBI should be used as little as possible in investigation of unaccused citizens except when they are to have access to secret information.

THE AEC FELLOWSHIPS: SHALL WE YIELD OR FIGHT?



Leo Szilard

The acquiescence of prominent educators in the congressional demand for non-Communist affidavits as a prerequisite for AEC fellowships in nonsecret research has offended many scientists. In the following article, Leo Szilard, professor of Biophysics at the University of Chicago, and a notable contributor to nuclear science, challenges his colleagues to defend academic freedom.

WHEN David Lilienthal was recently under Congressional attack because he had not taken care to exclude members of the Communist party from holding AEC fellowships, he pointed out that the holders of these educational fellowships were not, in general, engaged in secret work, and that those who were engaged in secret work had undergone the usual FBI investigations. Lilienthal expressed doubt that scientists would go along with measures that would inject political discrimination into the selection of applicants for educational fellowships.

As the intensity of the Congressional attacks increased, Dr. A. N. Richards, President of the National Academy, and Dr. Detlev W. Bronk, Chairman of the National Research Council, which awards the AEC fellowships, expressed their willingness to accept the requirement of a non-Communist affidavit.

There was some talk of subjecting all applicants for AEC fellowships to an FBI investigation, and to many scientists, this seemed to be much worse than the requirement of an affidavit. Presumably to ward off this evil, five distinguished members of the executive committee of the American Institute of Physics issued a statement opposing such an FBI investigation, but at the same time saying that the demand for a non-Communist affidavit was reasonable.[1]

I think these men would be embarrassed if they were asked just why they thought that the demand was "reasonable." I think it is quite clear what is happening here.

Those who sit in the Councils of our learned societies want to be practical. They know that, as things stand at present, holders of AEC fellowships will be required to sign non-Communist affidavits no matter what the scientists may say or do. So they say to themselves, "Why fight a losing battle? Let's accept the lesser evil so that we may avoid a bigger one. If we say that a non-Communist affidavit is reasonable, most people will conclude that we are reasonable, and they will listen to our arguments as the arguments of reasonable men."

Are we scientists going to follow the principle of the lesser evil? Our colleagues in Germany have trodden that path.

A few months after the Hitler government was installed in office, it demanded that instructors of the Jewish faith be removed from their university positions. At the same time, every assurance was given that professors who had tenure would remain secure in their jobs.

The German learned societies did not raise their voices in protest against these early dismissals. They reasoned that there were not many Jewish instructors in German universities anyway, and so the issue was not one of importance. Those of the dismissed instructors who were any good, so they pointed out, were not much worse off, since they were offered jobs in England or America. The demand of the German government for the removal of these instructors did not seem altogether unreasonable, since they couldn't very well be expected wholeheartedly to favor the nationalist revival which was then sweeping over Germany. To the learned societies it seemed much more important at that moment to fight for the established rights of those who had tenure, and this could be done much more successfully, so they thought, if they made concessions on minor points.

In a sense the German government kept its word with respect to those who had tenure. It is true that before long most professors who were considered "undesirable" were retired; but they were given pensions adequate for their maintenance. And these pensions were faithfully paid to them until the very day they were put into concentration camps, beyond which time it did not seem practicable to pay them pensions. Later many of these professors were put to death, but this was no longer, strictly speaking, an academic matter with which the learned societies needed to concern themselves.

The German scientists could not, of course, have saved academic freedom in Germany even if they had raised their voices in protest in the early days of the Nazi regime when they still could do so with impunity. They could not have changed the course of history, but they could have kept their hands clean.

THE non-Communist affidavit which will be required from applicants for AEC fellowships is so phrased that a student who is a member of the Communist party cannot sign it without making himself liable to prosecution. It matters not whether he does or does not advocate the overthrow of the Government by force or violence. It matters not whether our courts rule that the Communist Party does or does not advocate the overthrow of the Government by force or violence.

If a student advocates the overthrow of the Government by force, maybe he ought to be put in jail. But if he does not violate any laws, then it is difficult to see how it is possible under the Constitution to discriminate against him or to bar him from educational opportunities provided at the taxpayers' expense. Is it permissible so to discriminate against a minority of law-abiding citizens whose political views we dislike?

[1] Printed on the opposite page.

Perhaps there is a loophole in the Constitution. Or maybe in times of stress the Constitution gets stretched a bit. Scientists are not qualified to judge such legal issues, yet we scientists cannot help being concerned.

AS CITIZENS, we are bound to be concerned because we are asked to sanction something that comes very close to the persecution of a political minority. And as scientists we are bound to be concerned because the Government will henceforth send us men to work in our laboratories who have been selected in a manner contrary to the tradition that has prevailed for over a century at our great universities, as well as at the universities of Western Europe.

What are the overriding national interests that require us to pay such a price? And if there are none, why should we condone political discrimination of this sort?

It is well to remember that there was a wave of persecution of Communists after the first World War under Attorney-General A. Mitchell Palmer, at a time when Russia represented no military threat to the United States, and, in many ways the persecution then was worse than anything that has happened this time—so far. But this time, the scientists are being asked to sanction persecution by accepting students into their laboratories on the basis of a selection that is not free from political bias.

If there are no overriding national interests involved, why should we tolerate the breach of a tradition which has hitherto prevailed at our great universities, even though not all of our universities abided by it with equal tenacity?

It is a vital part of this tradition that scientific ability be made the sole criterion for the selection of those who are given facilities for research or faculty appointments. The requirement of a non-Communist affidavit is the first breach of this tradition that has resulted from accepting Federal aid to education, and there is every reason to expect that others will follow.

Federal aid to education may be a necessity, but Federal political control of education is an evil. This evil our universities will not be able to resist unless scientists take a stand based on the major principle which is involved, and on which they are united. Once we give up this stand and retreat, there is no second line of defense behind which we can unite.

If asking for a non-Communist affidavit is reasonable, then it is also reasonable for the Government to refuse to take an applicant's word for his not being a Communist, and to *investigate* all applicants. And, if it is reasonable to investigate holders of AEC fellowships, why is it not equally reasonable to investigate holders of fellowships from the National Science Foundation? And if a university receives Federal aid to its educational and research program, is it not quite reasonable to investigate the members of the faculty and the students who benefit from such aid?

Those who reconcile themselves to the first breach of our tradition will in due time reconcile themselves to a second breach. Those who follow the principle of the lesser evil will have to retreat again and again. If we do not take a stand on the first occasion, when our most valued tradition is threatened, we shall never take a stand.

The scientists, ever since they scored a major victory in defeating the May-Johnson Bill, and thus helped to bring about civilian control of atomic energy, have been very conscious of the importance of their good public relations. Many of them think that it is better from the viewpoint of public relations to appear "reasonable" at this time, and to make concessions, rather than to take a fighting stand.

They might be right about this, for this time, if we give battle, we cannot be sure that we shall win.

But there are more important things for us to think about these days than our good public relations. There are more important considerations than our natural desire to win every battle. There is justice to think about, and freedom, and our integrity.

Justice and freedom have never been secure for very long in any one area of the world. None of us can say for sure what fate awaits them in the United States in the crisis through which we shall be going in the remainder of this century. Freedom and justice might survive this crisis; or they might not. They might perish and the efforts of scientists might be of little avail. What we scientists *can* do is to resolve that they shall not be allowed to perish without a fight. And those of us who do not wish to fight can at least refuse to help dig the grave.

Oppenheimer's Letter

(Continued from page 168)

evidence; they take into consideration questions of opinion, sympathy, and association in a way which is profoundly repugnant to the American tradition of freedom; they determine at best whether at a given time an individual does have sympathy with the Communist program and association with Communists, and throw little light on the more relevant question of whether the man will in later life be a loyal American. It would be foolish to suppose that a man against whom no derogatory information can be found at the age of twenty was by virtue of this guaranteed loyal at the age of thirty. It would be foolish to suppose that a young man sympathetic to and associated with Communists in his student days would by that fact alone become disloyal, and a potential traitor. It is basic to science and to democracy alike that men can learn by error.

4. My colleagues and I attach a special importance to restricting to the utmost the domain in which special secret investigations must be conducted. For they inevitably bring with them a morbid preoccupation with conformity, and a widespread fear of ruin, that is a more pervasive threat precisely because it arises from secret sources. Thus, even if it were determined, and I do not believe that it should be, that on the whole the granting of fellowships, or, more generally, of Federal support, to Communist sympathizers, were unwise, one would have to balance against this argument the high cost in freedom that is entailed by the investigative mechanisms necessary to discover and to characterize such Communist sympathizers. This is what we all have in mind in asking that these intrinsically repugnant security measures be confined to situations where real issues of security do in fact exist and where, because of this, the measures, though repugnant, may at least be intelligible.

You and I have had occasion to discuss in the past how central a place the control of atomic energy occupies in the preservation of the basic freedoms of inquiry, freedoms essential at once for scientific progress and for the preservation of our democratic institutions. It is because I believe that the issue which has been raised here bears directly on the maintenance of freedom of inquiry that I hold it so important that it be wisely resolved.

With every warm good wish,

ROBERT OPPENHEIMER

REFLECTIONS ON GOVERNMENT

Edward U. Condon

The following paper by the Director of the National Bureau of Standards was written before the current attacks on the administration of the atomic energy program. Recent events have increased the force of Dr. Condon's observations.

I WILL use as my point of departure a paragraph from an article by Harry Aubrey Toulmin, Jr. which appeared in the April 4 issue of *Chemical and Engineering News*. This paragraph says:

". . . when you lay the dead hand of government bureaucracy upon any creative enterprise, you reduce the adventure to one of rules and regulations, of civil service requirements, to preserve mediocrity in its perpetual vacation at government expense. You furnish opportunities for so many small minds, comfortably positioned, by reason of political affiliation or civil service good fortune, in situations where jobs are made by keeping a host of rules and regulations to sterilize every thought, every independent action, and every interesting adventure in the field of science."

These remarks are admittedly extreme ones. I doubt that many others have voiced themselves as strongly or as bitterly.

I take issue with such remarks. Criticism like this is not only grossly exaggerated but stands on ground that is essentially destructive in nature. Although not usually put in such extreme language, especially in a scientific periodical, nevertheless, I have noticed rather more of such talk than I think is good or well-founded.

It happens that I have had personal experience on the faculties of several of our leading universities, on the staffs of a leading industrial laboratory and of two major war research projects, Federally financed but privately operated, and now several years of service, including the ordeal by smear, with a major scientific laboratory of the Federal Government. That covers the gamut of possibilities almost as completely as those enumerated and eliminated one by one in Arthur Roberts' famous song entitled "Placement."

I have noticed something seriously wrong with the operations of every one of these places where I worked. I have wondered about this a great deal. Of course, they all had in common the fact of being places where *I* had a finger in the pie, and that may have been what was wrong with them. But I have come to the conclusion that this hypothesis would exaggerate the amount of my influence on them. I think the real root of the difficulty was that other feature which they all had in common, namely, that they were all human institutions, run by human beings.

If you think back over all the troublesome and annoying situations you have ever been in, you will find that the trouble was usually caused by human beings, if not by yourself, then by someone else.

That, I think, is what is wrong with the Government, if anything, and in this respect it is no worse and no better than all our other group activities, namely, that it is run by people; just plain ordinary people, like you and me. Maybe we should get a machine to do these things for us. Maybe we should turn the whole business over to some grand super servomechanism, a machine whom we might name Mr. Cyrus Berneticks; by those who are already well acquainted with him personally, like Norbert Wiener, he could be referred to familiarly just as Cy Bernetics.

Aldous Huxley in his *Brave New World* satire was going to do all this with special breeds of people, not at all like the little old fallible folks that we know, but this would take generations of very fancy breeding. We physicists and electronic engineers cannot wait that long: we will do it with electron tubes and thyratrons, mercury delay lines, cathode ray tubes, and the like.

In the meantime we have to live together and with our Government as best we can for I am sure it will take some time for enough of us to master the books of Wiener and of von Neuman and Morganstern well enough to be able to build this super governmental machine.

There is another reason why we had better not chuck our Government too quickly, why we should patch it up and make it work as best we can, and that is this: I have noticed that, strangely enough, whenever there is some really major undertaking to be carried out, the Federal Government is usually found to be the outfit to do it. We entrust all sorts of important activities to it—such major projects as conservation of natural resources, reclamation of deserts for fruitful agriculture, and most of the basic research on aeronautics. Why we even entrust the national defense to the Federal Government!

In the last war, when we needed all sorts of special scientific gadgets in a hurry, we not only utilized to the fullest the facilities of existing government agencies, but hastily threw together a special one, the O.S.R.D. of long and well-remembered fame. Under the doughty leadership of Dr. Vannevar Bush we proceeded by this means to lay the "dead hand of government bureaucracy" on the business at hand, and to produce micro-wave radar, proximity fuses, and the atomic bomb.

To refer to such things, and to the regular as well as the wartime activities of the Government's research laboratories as being situations in which mediocrity is preserved in perpetual vacation at government expense is so much stuff and nonsense. The chemists should know better than to print such stuff in their journal.

I AM not, you understand, trying to maintain that the Government is by any means perfect or even that we should be satisfied with it. I have had enough experience, especially some which I am not at liberty to make public, to convince me that this is not the case. I hope you will take my word for this without having to have similar experiences yourselves. I am merely trying to say that I think the Government is here to stay, as is Harvard or Princeton or even Cal Tech.

An address given at a banquet of the American Physical Society, Washington, April 28, 1949.

I will go further: I will even make such an unsubversive remark as to say that I think our experience has shown that we have a mighty fine form of government with a lot of very precious things in it, such as the Bill of Rights of the Constitution.

These things being true I think we should turn a deaf ear to those who make such foolishly exaggerated statements as are contained in the paragraph I have chosen as my text. Instead we should work together, all of us, both inside and out of the Government service, to study and solve the administrative and political problems of our Government's scientific laboratories, to the end that we can work toward their steady improvement and increased efficiency. This is the method we use in our private affairs and in business and in our universities. This is the method by which we should approach all problems of government.

Altogether too much has been said in the past about the bad features of working for the Government. It has been my experience that most of this comes from people who have either never worked for the Government or did so many years ago. If any first-rate physicist doubts my word, let him come to work in the Government service. He will find that most of the bad things he may have heard are not true and that he will have the opportunity to work in splendidly equipped laboratories and libraries with a splendid group of associates who are just as able and as devoted to the progress of science and to public service as any persons he could find anywhere.

Out there on Connecticut Avenue we are continuing to raise a National Bureau of Standards to which the wise and honest physicists can repair.

THERE is, however, a more serious matter to which I ask leave to direct your attention. For some time past there has been in this country a somewhat alarmed concern over the possibility that there may be at large among us some disloyal persons whose attitudes are such as to lead them to commit disloyal or treasonable acts. Ever since the report of such affairs in Canada reached us in 1945, we have been unable to rule out this possibility. In the past several years a great deal of time and effort has been spent on the problem of seeking out and eliminating any such persons from positions of trust.

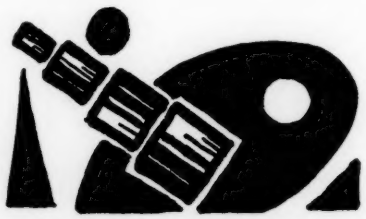
This is an important function of government which we confidently entrust to the "dead hand of government bureaucracy" in the form of the Federal Bureau of Investigation.

If that is all there were to the matter, there would be no cause for alarm. Seeking out evidence of disloyalty is an unpleasant business which becomes all the more unsavory if one finds this evidence. But the serious matter which I alluded to is the fact that many persons are using, or trying to use, or would be willing to use, or would be willing to see used, this proper activity for partisan political purposes, for the trumping-up of attacks directed at persons whose only offense is that they think differently on some specific policies than do the attackers.

THIS is a matter which should be of great concern to all decent Americans, for it is a most un-American approach to our problems. I feel that it is particularly a matter of concern for scientists and university people at this time because there are signs that they will be the particular butt of an increasing number of attacks of this kind.

I know that most of you would like to believe that the crisis was passed last November and that everything is all right now. Unfortunately, that is not so. Maryland has just adopted a law which many feel could have un-American consequences, and state legislative committees on so-called subversive activities are actively at work in Washington, California, and Illinois, and perhaps other states. Several, perhaps all, of these committees are directing their attention to the universities, and to scientists in particular, in a way that is strikingly reminiscent of the wave of anti-intellectualism which formed an early part of the Nazi rise to power in Germany. The Nazi formula is being applied here with practically no variation from the way the Nazis were using it just fifteen years ago.

Recently several young members of the American Physical Society were summoned before executive sessions of the House Committee on Un-American Activities. Let us hope that the careers and reputations of these young scientists will be fairly dealt with, instead of being subjected to the kind of smear attack which was so prevalent last year.



Scientists connected with the atomic bomb project during the war have received more than their proportionate share of attention from the old House Committee. This is partly accounted for by the sensational news value of the atomic bomb project. Some might think that it reflects unfavorably upon the ability to organize adequate security measures of the army officer who was in charge of this project during the war. This surely could not be a correct interpretation of the facts, as the security organization of the Manhattan District was unusually large and effective.

Moreover, I do not believe that there is anyone in the Government who sincerely believes that there were any serious failures of security on the part of the loyal team of physicists, chemists, and engineers who carried the atomic bomb project through successfully.

WHAT then is the real purpose of these harassments and persecutions? I do not believe there is any single answer, but I believe I can give several components of a multiple answer. I will leave to you the more difficult problem of assaying the relative contribution of these several components.

First, I believe that there is growing in this country a widespread anti-intellectualism which is violently opposed to free speech and free discussion, unless the views expressed happen to fit its own stereotypes.

Second, I believe that there is a particular vindictiveness against the atomic bomb scientists on the part of persons annoyed by the part these scientists played in securing the legislation which established the present civilian Atomic Energy Commission.

Third, I believe there is a larger group of American isolationists than is generally realized. They have been operating largely underground until now, but in the near future, they will be increasingly bold in trying to put over the idea that world government, or international co-operation programs of any kind, or even the United Nations, are subversive and un-American. One step in paving the way for this is an attempt to discredit or intimidate those scientists who have stressed the inescapable necessity of working toward the one-world concept.

Fourth, I do not omit the possibility that some honest and sincere persons have been unstrung by the general tension and hysteria and genuinely believe that the scientists are untrustworthy fellows.

There are probably a lot of other components in this stew, but these seem to me to be the important ones.

I do not want anyone to construe anything that I have said at any time as opposition to fairly and competently conducted inquiry into suspected subversive activity. But I do want to be on record against incompetence in such investigations and against their being conducted in an atmosphere of hysteria-generating publicity.

I WOULD like in this connection to express a few opinions concerning the President's Loyalty Program for investigation of employees of the Federal Government. I think that this program is and has been a splendid thing, given the situation of which it is a part.

In the spring of 1947, just two years ago, hysterical political orators were telling the American people that their Government was honeycombed—I believe that honeycombed was the usual word—with disloyal employees. If this were true, we all agree, it would be a pretty serious matter.

The President took cognizance of these serious charges by setting up an orderly mechanism for investigating, from this point of view, every one of the more than two million employees of the Federal Government. This provided for hearings, privately conducted, for any employees about whom derogatory information was produced, followed by an appeal and review procedure well designed to minimize as far as possible any possible injustice. It was splendidly devised and, in the main, carried out with fairness. Political opponents of the President, having labored hard to spread the accusations which made the program necessary, now tried to represent it as being an admission on his part that their accusations had some foundation.

BUT the outcome proved quite otherwise, and the blame for all the needless expense, disturbance, and personal suffering which these investigations have caused should rest squarely on those who raised the false alarms.

Of course the whole thing was a dirty and unpleasant business. Some of the "charges" made are ridiculous, that is, now that it is over.

For example, if I did not have a transcript to prove it, I doubt if many would believe me when I say that in my own loyalty hearing I was asked about an accusation that "you have been highly critical of the older ideas in physics!"

When I heard this I could hardly believe my ears. However, there is one thing that one must not do with inquisitors, and that is to appear not to take them seriously. So I went into an impassioned affirmation of faith in Archimedes' Principle and the general correctness of Newton's Law of Gravitation.

It must have satisfied them, for I have had the pleasure of adding their "clearance" to my collection, which I feel may be the largest collection of clearances in the country.

Nevertheless, I want to say again and emphatically that, given the hysterical political atmosphere with its grossly unfounded accusations, the President's Loyalty Program did a wonderful job in giving a fair hearing to many persons who would otherwise have been the unprotected victims of false accusations from whatever unscrupulous source they might arise.

Along with many others, I had thought that this fever was burning itself out. But a recent tour across the country gave shocking evidence of the way in which various state legislative committees are becoming active in attempting to discredit university scientists, merely because a few scientists entertain minority views. It seems to me to be my duty to give this warning of the dangers to America of that attack and to urge all scientists, in each local community, to give serious attention to the menace to our Constitution of these attempts to "lynch by label." Let us not give such exclusive attention to the threat of totalitarianism on the left, that we let ourselves be engulfed by the totalitarianism on the right.

IN closing, let me remind you that the late Senator Huey Long of Louisiana is reported to have said, more than a dozen years ago, when we were just beginning to worry about the threat of totalitarian governments in Germany and Italy, that if fascism ever comes to America, it will come in the guise of 100 per cent Americanism.

I feel keenly that it is our duty and responsibility to think clearly and carefully about these danger signs appearing in our country. I would like to be able to believe that I overestimate their importance, but the past decade alone provides for us too many examples of nations where the people who ignored the symptoms of totalitarianism, ignored the symptoms of the disease until it was too late. Anti-intellectualism precedes the totalitarian putsch, and anti-intellectualism is on the upswing here.

There is an aphorism about letting sleeping dogs lie—and many of us are tempted to do just that. But that aphorism is not applicable here, for the dogs to which I refer, while they have been doing plenty of lying, are certainly not asleep.

Washington Notes

(Continued from page 165)

done before the Committee and in public, and that "a division line can be made, and explicitly made, between secret and nonsecret" matter, with the secret testimony kept to a minimum and presented in supplementary executive sessions. He appeared confident that the record of over-all accomplishment, once it had been set forth, would fully vindicate the AEC.

The Commission's critics were nonplussed, at least temporarily. Its friends in the Congress, strongly supported by the press, insisted that there must be a complete and fair investigation of the whole situation. Obviously unprepared for this kind of an offensive, Hickenlooper lamely requested that the Joint Committee go into executive session for the purpose of determining the order of procedure in conducting the inquiry.

Thus by firm, decisive action, the AEC succeeded for the first time in two rough weeks in righting a distinctly rocky boat. At the end of May the consensus of opinion at the Capitol was that Lilienthal might be in for a tedious and perhaps painful investigation. New items of the painful variety kept cropping up—a report on May 27 by a Joint Committee subcommittee which criticized the Commission's "patently questionable" natural gas project at Oak Ridge. But both the AEC and its Chairman had earned better than an even chance against their enemies and with their friends. And the most important by-product of the storm was the prospect that a thorough look at the atomic energy enterprise could strengthen the Commission by endorsing its general excellence, revealing its errors, and helping to bring the Congress and the man on the street a little closer to a sense of what the atom is all about.

HICKENLOOPER VERSUS LILIENTHAL

THE ACCUSATION

On May 22, Senator Bourke B. Hickenlooper, former Chairman and now the ranking member of the Joint Congressional Committee on Atomic Energy, issued the following statement demanding the resignation of Mr. Lilienthal, AEC Chairman, on charges of "incredible mismanagement."

In the national interest, the time seems to have come for some plain talk about the Atomic Energy Commission. The Atomic Energy Commission is now staggering under daily disclosure of evidence of incredible mismanagement. The Joint Congressional Committee on Atomic Energy is about to begin a series of public hearings which could turn into a carnival of confusion, so as a Senator who has devoted most of the last three years to this subject, I feel it is my duty to speak plainly before major damage may be done to our atomic energy establishment and to the principle of civilian control.

On the matter of the missing uranium, the facts are:

1. A container of about 9 to 10 ounces of uranium oxide enriched with 32 grams of Uranium 235 was discovered missing at the Argonne National Laboratories, Chicago, on February 8, 1949. The AEC Chairman, David E. Lilienthal, has attempted to minimize this quantity. He has sneered at the nation's "four-gram jitters." The truth is that for research in the field of weapon development, this is a vast quantity of this precious material. Dr. Allen May, the British scientist, drew a ten-year prison sentence for stealing 1/1000th of a gram of U-235; and we began building Hanford before we had as much as is still missing.[1]

2. The AEC, in direct violation of its duty, did not notify the FBI of this loss until March 28, 1949. Mr. Lilienthal has declared that there was no suspicion of theft or espionage. This is completely untrue. The FBI was called in only because there was suspicion of theft and espionage, and, though the trail was completely cold, the FBI made its investigation on the assumption of theft and espionage.

3. The AEC did not notify the Chairman of the Congressional Committee until April 27, 1949, though the law requires that such notification be made immediately.

4. When this loss was reported publicly on May 17, 1949, by the *New York Daily News*, Mr. Lilienthal replied that the loss was trivial and that it was being partially recovered, from "waste."

There is no satisfactory evidence to support this claim. It is true that some U-235 is being recovered from waste—this is a process which goes on constantly—but there is no satisfactory evidence that what is being reclaimed is indeed from the missing parcel.

We have no conclusive evidence that a theft has been committed but neither do we have conclusive evidence that a theft has not been committed.

What makes this situation deeply disturbing to me and other colleagues is this: We have learned from the records that there are numerous persons employed on our atomic projects who have strong Communist leanings. We have urged Mr. Lilienthal to adopt a realistic attitude toward these dangerous persons, but he has not been responsive to our urgings. And if two-thirds of a pound of uranium compound[2] can disappear without either the FBI or the Joint Committee being notified for six weeks, how can a responsible member of Congress have any confidence in Mr. Lilienthal's management?

In the matter of the fellowship program, the situation is this:

Tomorrow, Dr. Isidore S. Edelman, a 29-year-old scientist, will appear before the Congressional Committee to try to salvage his career. He is no doubt a brilliant young man, and the publicity given him is tragic to himself, perhaps even to the nation. But this is a tragedy which must be laid at Mr. Lilienthal's door.

Dr. Edelman had earlier applied for work in the AEC laboratories, but the AEC's own Security Department ruled that he could not be cleared for access to restricted atomic information. When Mr. Lilienthal insisted, in the face of this report, on awarding Dr. Edelman a fellowship, the Joint Committee warned him that he was being unrealistic and unfair.

A student or his wife having been Communists does not render him ineligible for public education in America. It does not render him ineligible for aid in private foundations. But because of the realities of our time, because there is a Communist conspiracy against democracy and peace in the world, it does render him ineligible for education in the atomic field at government expense.

Because of this reality, Mr. Lilienthal was urged to approve no student for an AEC fellowship until the applicant had been given an FBI investigation. Mr. Lilienthal flatly refused to admit even the propriety of an investigation, and Dr. Edelman's tragic experience is the result of this doctrinaire obstinacy.

It is my hope that after Dr. Edelman's appearance, the necessity for making public spectacles of Mr. Lilienthal's mistakes will be eliminated. I hope that the AEC will now quietly cancel all fellowship students who cannot qualify as good security risks.

Public hearings should, of course, be afforded these persons involved who, themselves, insist on it.

In addition to these two highly publicized fiascoes by Mr. Lilienthal and the AEC, in my opinion, there is now perhaps even more serious evidence of maladministration. Our atomic program is suffering from equivocation, misplaced emphasis, and waste. There are a number of important problems, the solution of which requires administration by the Chairman of the AEC which is competent, realistic, and courageous.

It is my considered opinion, in the light of the record of the past two years, that the interests of the nation can best be served by the President's requesting the resignation of Mr. Lilienthal.

[1] Natural uranium, available to the Soviet government in ton quantities, contains some 6000 grams of U235 per ton. The lost material contained, according to Senator Hickenlooper, 32 grams of U235 in about 255 grams, i.e., it was enriched 18-fold but was only 12% in the fissionable isotope. It is misleading to rank the loss of this material *today* with the theft *four years ago* by Dr. May of "slightly enriched" U235. Actually, Dr. May additionally confessed to having transmitted secret information and one ten-thousandth of a gram of U233, which latter does not occur in nature.

[2] "Two-thirds of a pound of a uranium compound" is itself an entirely negligible quantity. The McMahon bill does not even require registration of such quantities in private possession. The whole value lies in the enrichment.

THE REPLY

In the letter printed below Mr. Lilienthal replies to Senator Hickenlooper's charges:

DEAR SENATOR MCMAHON:

A full, complete and speedy report on the charges that the United States Atomic Energy program is virtually a failure is a matter urgently necessary; the investigation initiated by the McMahon committee and to be carried out by it is welcomed.

The charges by Senator Hickenlooper of "incredible mismanagement," "misplaced emphasis," and "maladministration" involve nothing less than the security of the nation and the peace of the world.

If it is true that the atomic energy program is in an almost bankrupt condition, then this nation, far from being the custodian and trustee of a substantial stockpile of atomic weapons, and in a favorable production situation, is in a sadly weakened condition. If this were true it is difficult to imagine any single fact more disturbing to the peace of mind of the people of the country or to the security of the world's democracies.

The facts on this crucial test of our stewardship can be readily established.

That in an enterprise requiring the services of some 60,000 human beings there have been mistakes and errors goes without saying; this has been freely admitted. Working with the atom does not make human beings perfect and beyond error. For these errors and mistakes the Commission has and will continue to accept full responsibility.

The failure to follow explicit Commission regulations in the matter of the uranium oxide at the Argonne Laboratory in Chicago is such an instance. In the handling of many of thousands of tons of crucial materials, in various forms, the Commission and its contractor-employees have sought and will continue to seek to improve on methods of accountability that will keep the element of human fallibility at a minimum; no system can eliminate the human factor entirely.

Among the hundreds of decisions of policy thus far made by the Commission, and those that will be made in the future, there are many the soundness of which is and will be subject to differences of judgment among equally sensible men. Such a case is that concerning scholarships for nonsecret study, awarded by the National Research Council of the National Academy of Sciences as contractor for the Commission.

The policy of the Council and the Commission has in the past ten days been changed to meet the objections, on public policy grounds, strongly expressed by members of the Congress. But the difference was one of judgment on which equally patriotic and reasonable men could have and do entertain differing views.

The export of isotopes to scientists abroad, announced by the President in September, 1947, is another instance. This was done upon the unanimous recommendation of distinguished advisors to the Commission. There are bound to be cases of underestimation of construction costs by contractors of the Commission in connection with urgently needed facilities of a wholly new kind. These are properly subject to criticism. But they were common experience during the war and today in industry generally.

The Joint Committee on Atomic Energy of the House and Senate was established by the McMahon Act to review and consider, among other things, differences of judgment on policy, and to receive and consider and appraise the rate of progress, or lack of progress in the substantial work of this project —one of the largest enterprises and most complex in history. Numerous reports, largely secret or top-secret, and frequent hearings, conferences, and staff liaison have made your committee essentially—and rightly so—a continuous congressional investigating committee.

The test of whether there has been and is "incredible mismanagement" and a grave situation in this country's atomic energy program can be made a quite specific test, or series of tests. The country, I suggest, is entitled to and will want to know the answers to such specific questions as the following, among others, and we welcome the decision of your committee to proceed to the making of such analysis of report.

1. Has the Commission failed in its stewardship at a time of great tension in its obligation paramount to all others; i. e., the production and improvement of these complex scientific weapons? What is the state of our atomic weapons—the order of magnitude of the stockpile; the improvements made in the past two and a half years in new weapon design? What has been the progress in the past two and a half years of our stewardship? What is the progress today in still further improvements, and the quality of personnel and the morale of those engaged in this work?

2. How about production of fissionable materials—the essential ingredients of atomic weapons? Is it on a secure basis? What situation did the project face concerning disruption of production and how successful were the steps taken to overcome them? We assert, and our reports to you have made clear, that production is now at the highest level in history, with the same facilities; that new facilities are approaching the production state.

3. How has basic and applied research progressed since the Commission took responsibility—and where was it when the Commission took over?

4. How about security?

What was the state of physical protection of plants when the Commission took over? Has this improved, and in what ways?

What about security of secret documents—what was the situation when the Commission began, and what is it today?

What about accountability for source and fissionable materials? What was the situation in 1947? What is it today?

5. What about the investigation and clearance of personnel—what was the situation, and what is it today?

There are many other areas of inquiry that your committee will engage upon, in addition to those carried on by it continuously as a regular practice in the past.

But the chief question I believe is this: Is this country weak today in atomic weapons and materials, and in their production and improvements, as implied by the broad and grave charges leveled against the Commission?

It can be stated categorically that the record in this respect is a proud one. It is one to give great reassurance to the peoples of the world who, as of this hour, rely upon the strength of the United States of America.

In order that the fears and misapprehensions on this score may be settled beyond peradventure and as promptly as it is possible, it is urged that the Joint Committee call before it immediately not only the Commission, its staff, its principal industrial and university contractors, but also other citizens of the highest renown and technical standing, including the distinguished members of the General Advisory Committee and other advisory groups for their testimony and appraisal. In this way the dangerous cloud of uneasiness resulting from these charges will be dispelled.

Sincerely yours,

DAVID E. LILIENTHAL

FAS ANNOUNCES POLICY DECISIONS

The first four statements appearing below were adopted at a meeting of the Governing Council of the Federation of American Scientists, held in Washington on May 1; the fifth statement (on the AEC investigation) was issued by the Federation's Administrative Committee, after an emergency session in New York on May 31.

NATIONAL SCIENCE FOUNDATION

DURING the recently concluded hearings on National Science Foundation legislation before the House Committee on Interstate and Foreign Commerce, strong opposition to the entire Foundation concept was voiced by the National Patent Council. It appears that this organization has succeeded in arousing unfounded fears among small manufacturers and business men that the Foundation "would inevitably dry up the creative fountainheads of American Industry by stifling individual incentive to invent and produce." In recent weeks congressmen have had a steady flow of mail urging this point of view. The majority of the committee now considering the legislation is not likely to be impressed, since they have given sufficient study to the bills to recognize the falsity of the charges. But other congressmen, who will make the final decision on the House floor, may be impressed if their mail continues to be predominantly opposed to the bill.

The great majority of scientists, whatever the disagreements on detail, favor the establishment of a National Science Foundation. The long course of the legislation can be finally and successfully ended in the next month. It must not be jeopardized by silence on the part of scientists, silence which will be interpreted as indifference. The Federation of American Scientists calls upon all scientists and their organizations, recognizing that this is the critical hour for establishment of a National Science Foundation, to communicate directly with their own representatives in Congress urging them to vote for the National Science Foundation Act of 1949 when it reaches the floor of the House.

BIKINI REPORT

The Report of the President's Evaluation Committee on the Bikini atomic bomb tests has been cleared for publication by military security, but is still withheld from publication by high governmental authorities. The Federation of American Scientists urges that this report be made public, since the information it contains will contribute to public understanding of the issues involved in the utilization and control of atomic energy.

DISCUSSION OF INFORMATION ON BOMB STOCKPILE

Any attempt to muzzle public discussion is a real threat to the future of our country. The number of available atomic bombs in the U. S. is known to only a few top military and government officials. The President of the United States has asserted at a recent news conference that the atomic bomb stockpile is not a matter for public discussion.

Clearly this information has great importance in evaluating our military defense program and foreign policy. While admitting that publication of this information might be of some benefit to other countries, we must, nevertheless, weigh this against the break with our traditional policy of informing the public on matters of national welfare. *Should the Congress and the public be told the number of atomic bombs in our stockpile?* The Federation of American Scientists supports the proposal which Senator Brien McMahon made in an address before the Economic Club at Detroit on January 3 (reprinted in the *Bulletin of the Atomic Scientists*, March, 1949), that this important question should receive full public discussion.

THE STRAND CASE

The Federation of American Scientists is concerned about implications for scientific freedom involved in the charges made by Dr. A. L. Strand, President of Oregon State College, in justifying his decision not to renew the contract of Dr. Ralph Spitzer, Associate Professor of Chemistry. The basic charge made against Spitzer is that he is a follower of the Communist party line. Statements received by the Federation from Spitzer and Strand show that the only evidence presented publicly in support of the charge against Spitzer is a letter written by him to a technical journal. From this Strand concludes that Spitzer "quotes the charlatan Lysenko in preference to what he must know to be the truth. . . . Any scientist who has such poor power of discrimination as to choose to support Lysenko's Michurin genetics against all the weight of evidence against it is not much of a scientist, or, *a priori*, has lost the freedom that an instructor and investigator should possess." Spitzer pointed out that in his letter he did not "support or accept Lysenko's theories."

Without passing judgment on the validity of any biological theory, the Federation, nevertheless, is concerned about the issue of orthodoxy in scientific thought which appears to be raised in the charges of the Oregon State College President. No scientific theory is "right" or "wrong" just because it is espoused by a particular national group or government. The validity of scientific theories ought to be determined, now and in the future, just as it has been in the past—by experimental methods. It is deplorable that Lysenko's theory has been made a matter of national policy of the USSR; it would be equally deplorable to make *any* theory, in any field of science, a matter of national doctrine. There is no surer way to stifle science.

Present scientific knowledge does not entitle anyone to be dogmatic about the nature of hereditary processes. Genetic theory is undergoing continuous modification under the impact of new facts gathered both in the United States and abroad. This process is hindered when decree is substituted for the time-tested method of experiment and scientific discussion—whether this is done by exponents of the Lysenko school, or by the President of Oregon State College. In the long run, the principle of free scientific thought and opinion will prove more important than the fate of any individual theory.

CONGRESSIONAL INQUIRY INTO AEC ADMINISTRATION

We have come to the unanimous conclusion that from the evidence so far presented, not one of the present attacks on the management of the Atomic Energy Commission is well founded.

This does not mean that we oppose a congressional inquiry into the activities of the Atomic Energy Commission; on the contrary, we welcome such an investigation, provided it is a full investigation openly conducted. Such an investigation must examine not only possible shortcomings of the Commission but also its areas of positive achievement. From our technical background, we hold that an open hearing can be held which will in no way endanger military security and which will open to public scrutiny the issues involved in the atomic energy program. Some of the misgivings voiced concerning the management of the Atomic Energy Commission are in fact due to the dark veil of secrecy which has kept its work hidden even in regions where there is no question of military security.

It is proper to point out that the accusations of mismanagement based on the loss of some uranium are wildly exaggerated. The loss of 4 grams of U-235 at the Argonne National Laboratory represents a careless slip on the part of someone in the laboratory. When chemists handle bottles by the score for years it will sometime occur that one such bottle is mislaid. Human error is inescapable. The accounting system of the AEC was adequate to catch the loss, and the task of salvage was carried on so successfully that out of the scrap and waste of a large laboratory all but a teaspoonful of the missing material has been recovered. To us this is an insufficient basis for a general attack on Mr. Lilienthal.

Two more charges have been made which are broader in their implications. One relates to the sending abroad of radioisotopes. No competent scientist would suggest that these materials have any connection with the manufacture of atomic weapons, though they are by-products of our large-scale atomic industry. They were discovered abroad years ago and have been available in limited quantities everywhere for a decade. We have merely made them cheaper and more readily available to research workers in fundamental science and to physicians applying isotopes to the study and treatment of disease. We need to recall that research has always been world-wide, and that American science and even the American atom bomb project have been built upon the fundamental researches of men in many countries. The terrible effects of the war have given Americans the responsibility to assist the intellectual as well as the economic rehabilitation of Europe as an act of simple humanity and a worthwhile investment in the future. To place an embargo on basic science, on the tools and materials of research, is unworthy of the dignity of a great nation. Such an embargo is ungenerous and even cruel; moreover, in the end, it will retard the growth of our own knowledge.

The last charge is based on the presence of one or two Communists among the hundreds of fellowship-holders of the AEC. Fellows working in secret fields are and should be subject to clearance procedures. We have considered the issues raised by the proposal to extend these measures to fellows in non-secret fields. Such fellows have no access to secret information, and therefore military security is not involved. We believe that oaths, affidavits, or clearance investigations are unnecessary and potentially dangerous to scientific progress. We endorse the original policy of the Atomic Energy Commission and the National Research Council of granting these fellowships solely on the basis of scientific competence.

There is a real opportunity in the present situation for the Atomic Energy Commissioners, the Congress, and the community at large, including scientists, to get together to re-evaluate their position, and to re-define their objectives and procedures. In so doing they can clarify in the public mind the issues involved in the proper utilization of atomic energy.

MEMBERSHIP CAMPAIGN

In the past year or more, there have been few issues which required extraordinary action on the part of scientists. Fortunately the Federation of American Scientists, which was influential in the fight for the McMahon Bill, has been able to maintain an effective organization. When the recent controversy arose in connection with the program of the Atomic Energy Commission, the Federation was able to get information to and from its members speedily and to put forward the attitude of scientists on these issues.

A concerted effort to expand the membership of the Federation of American Scientists was decided upon by the FAS Administrative Committee at a special meeting on May 29.

Already a nation-wide organization with active chapters in more than a dozen of the major scientific centers, the FAS also provides for affiliation of individual natural scientists as members-at-large, and other interested individuals as associate members-at-large. The membership is kept advised on current topics of particular interest, problems which can only be solved if there are many well-informed individuals working together. The members also lend support to an organization specifically alive to the role scientists play in public affairs, and willing to act or make known its position on relevant issues after policy is carefully determined by poll of the membership or by the Council.

All members-at-large of the Federation receive memoranda, releases, and the aperiodic *Newsletter* issued by the national office at 1749 L Street, Washington 6, D. C. Regular dues are $5.00 a year, supporting members paying $10, and patrons $25. The FAS is an active organization, respected in Washington and in scientific circles throughout the country. It is one which can be of service to busy or isolated scientists, and the vehicle for their expression on public issues.

President Truman Backs AEC

At a press conference on May 26, President Truman expressed his confidence in the AEC in the following statement:

I personally know the country's position in atomic energy. We are making good progress.

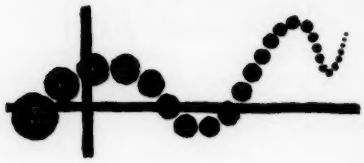
Our situation has been vastly improved in the last two years under the Atomic Energy Commission.

I deplore the fact that relatively trivial items have been blown up to proportions that threaten the integrity of the program.

It is time people stopped getting hysterical when the word *atom* is mentioned. The plain fact is that the atomic energy program is in good shape —and in good hands. I hope the Commission will soon be able to get back to work and that the atomic energy program will cease to be used for pre-election campaigns.

I have entire confidence in Mr. Lilienthal. He has done a good job.

PSYCHOLOGY AND STRUCTURE OF LARGE-SCALE PHYSICAL RESEARCH



L. Kowarski

The transition from relatively small research institutes to huge research establishments has compelled scientists to face new problems of organizational structure and of human relationships. How such gigantic enterprises can be effectively organized and smoothly run is here discussed by the Technical Director of the French Atomic Energy Commission. During the war, Dr. Kowarski took a leading part in the work of the English and Canadian atomic energy projects.

Introduction

THE recent advances of applied physical research — radar, transmutation, jet propulsion, thinking machines, to name but a few—have placed before every civilized nation a dilemma: either to develop an active interest in all of these fields or to sink to the level of providers of raw materials and cheap labor.

The worldwide character of this challenge is not without precedent: let us recall, for example, the history of the railways. The pioneering work of the British was followed quickly, and perhaps not wholly independently, by similar developments in France, Germany, United States, and elsewhere. Some latecomers, such as Russia, possessed of enough drive and educable manpower, were able after an initial period of dependence to complete the task and to continue on their own. Others, in South America or in Asia, remained for generations in the unprofitable position of importers of foreign machinery and skill.

In the history of the industrial revolution, that first phase which ushered in large-scale mechanical manufacture developed in the eighteenth century in Britain and spread to almost the whole civilized world. The second phase, in which organized applied research was allowed to correct and enrich industrial processes, originated in Germany at the end of the nineteenth century —and only the efficiency with which the Germans taught their lesson to the world prevented them from conquering it. The third phase of the industrial revolution, out of which basic science will emerge as the initiator and leader of industrial practice, cannot yet be said to have definitely occurred. But its shape has been outlined, and its methods tested, during the last decade.

Some beginnings of this new development can, of course, be traced to various countries, and to years preceding the Second World War. The public utterances of a Joliot-Curie, the purely scientific leanings of a Philips or a Bell Telephone Laboratory, give a glimpse of something new. It seems, however, that the decisive initiative was again taken by Britain. Much discussion and writing went on there all through the thirties.[1] By 1939, British scientists were ready to take their place in the highest governmental and military councils, to attack a wide variety of urgent problems,[2] and to deliver such goods as radar, scientific feeding of the whole nation, and decisive beginnings in the atomic energy field.[3]

The corresponding American effort, in spite of a somewhat belated beginning, very soon outstripped all its competitors. At present we still have to turn to these two pioneering countries for the best examples of large-scale research projects; this is due to a favorable combination of a high industrial level with the stimulus provided by the war and with freedom from foreign occupation, rather than to any mythological entity such as a specific Anglo-Saxon genius.

Today, while communications between industrialized nations are being restored and distinctions between different camps and categories are gradually lapsing from their wartime pitch, large-scale research developments begin to appear in the formerly occupied countries (the best instance is offered by the French Atomic Energy Commission) and in the formerly neutral countries (cyclotron projects in Sweden).

According to my own experience (derived from wartime participation in the British and Canadian atomic projects, followed by postwar work in France in the same field), every highly industrialized country offers a suitable ground for such developments. Favorable and unfavorable characteristics of various nations add up in a complicated balance, and we should avoid giving too much weight to any single factor, such as the presence of a certain useful industry or the absence of an essentially scientific tradition.

A last introductory word about the particular attention I am giving to *physical* research. Apart from the natural tendency to speak mainly about one's own field, this concentration of attention reflects the fact that postwar development is conditioned by its origin in a war which was as unmistakably "the physicists' war" as the previous one was "the chemists'." It is applied physics which today commands the greatest prestige and allegiance; and even among basic sciences, it is "pure" physics which today derives the greatest profit from wartime lessons in organization (for example, meson and cosmic-ray research).[4]

Prerequisites

A RESEARCH project undertaken on scale large enough to involve a nonnegligible proportion of the industrial resources of a nation, cannot succeed unless it gets support on a corresponding scale.

Access to raw materials, adequate budget provisions, cooperation of industrial and educational bodies, enthusiastic response of the eligible manpower, goodwill of influential persons —all these vital contributions can be readily forthcoming only in the at-

This article is based on a speech delivered at the Royal Institute of Technology, Stockholm, Sweden, on October 20, 1948.

[1] See in particular J. D. Bernal, *The Social Function of Science* (London: G. Routledge and Sons, 1939), and J. G. Crowther, *The Social Relations of Science* (London: Macmillan, 1942.)

[2] *Science in War* (Harmondsworth: Penguin Books, 1940).

[3] See J. G. Crowther and R. Whiddington, *Science at War* (London: His Majesty's Stationery Office, 1947).

[4] See J. R. Oppenheimer, "Physics in the Contemporary World," *Bulletin*, IV (March, 1948), 65.

mosphere of a united national effort. Every nationwide cleavage—Right vs. Left, Private vs. Government enterprise, Civilian vs. Military control—will be harmful and may go far to offset any material and technological resources a nation may otherwise succeed in mustering. Mere absence of cleavage is not enough. There must be an active cooperation among the *state* (both in its regulating functions, such as allocation of priorities and import quotas, and its financial functions, since private financing is usually inadequate even in America); *industry* (especially electronics, fine chemicals, fine metallurgy, precision mechanics); the *universities* (in their teaching, guiding, and research activities) and the *defense* establishments.

Now that there is practically no war, and we cannot rely any longer on this most primitive and effective of all stimuli to cooperation, we have to look for other moral forces. They are not the same everywhere. In France, there is a youthful drive toward the reconstruction and development of national productive resources; this drive is often adventurous and helps to cut red tape. In Britain, the ingrained civic sense often succeeds in turning to good account even the red tape itself. In the United States, individual and corporate profit motives get some—probably not unwelcome—help from the disinterested urge to keep abreast with the latest developments which is traditionally displayed by farsighted industrialists, by individual citizens, and now, increasingly, by public authorities.

Specific unifying impulses may also come from the desire to make full use of some particular national resource, whether material (as, for instance, in Canada or Norway), or moral (as, for instance, the existence of a radiochemical tradition in France, or of a well-developed physical science in Holland).

A UNIFYING motive, however necessary, is yet not enough. Large-scale research pays huge dividends in the long run, but long-range investments cannot be indulged in before the day-to-day survival needs have been satisfied. The per capita surplus left after such bare survival requirements now varies enormously from nation to nation. That is why Britain, with very nearly a third as large a population as the United States, produces in atomic energy an effort which is smaller than the corresponding American effort by a factor of at least ten. A similar comparison of France with Britain (let alone with the United States) reveals a still greater disparity corresponding to a still greater pressure of bare survival needs.

There must also be a surplus of spirit above the amount which is claimed by the everyday tasks of the individual. The recognition of a common aim and the sense of urgency must permeate all those who work in the research project itself, or have to contribute from outside. The importance of this inner drive is particularly great in organized *research*, because this new form of cooperative endeavor presents the individual with certain new problems of adjustment, for whose solution he cannot rely on any established tradition.

PATTERNS of hierarchy, "family trees," and rigid forms of subordination which have worked well in other fields of cooperation—industrial, military, and so forth—may suddenly fail when applied to a situation in which, as so often happens in the scientific practice, it can be said literally that nobody knows exactly what he is actually doing or going to do. Quick twists of direction or quick changes of emphasis may suddenly call on somebody's hitherto unused skill or know-how and put him in a position where he will have to give orders to those who were giving him orders a week before.

Clearly then, the *relative* position of a participant in a large research project cannot and should not be his sole basis of self-esteem. An absorbing interest in the common achievement, a democratic "it depends on me" feeling thus becomes necessary. Fortunately there is often an atmosphere of intimacy in which hierarchy may be allowed to become somewhat lax and hazy.

The imposition of an organizational framework, no matter how flexible or syncopated, may cause a not unjustified regret to professional scientists, most of whom have hitherto lived the lives of independent smallholders. In swallowing a minimum amount of this new and seemingly unavoidable evil, scientists may yet evolve a new approach to that dilemma of "Freedom vs. Organization" which, according to Bertrand Russell, is the central problem of modern history. It may be this contribution which J. D. Bernal had in mind when he wrote: "In some ways this organization was as important an invention as the liberation of atomic energy itself."[5]

In a research establishment animated by this healthy spirit, participants of every rank bring up suggestions and take initiative—and those who object to the resulting confusion should consider how much worse would be the opposite excess, and the stagnation to which it would lead. I have seen flowers in every laboratory at Chatillon, and, on the walls of the Birmingham synchrotron building, humorous progress charts depicting the "beneficial aspects" of Professor Oliphant's absences and the resulting suspensions of his perfectionist drive. Enthusiastic workers express their attachment to the job in surrealist paintings and in the thousand and one nicknames they give to their tools and inventions. A geometrical cross-section is judged to be "as easy to hit as a barndoor" and henceforth every textbook says "one barn" when it means one square micromicrocentimeter. Catalogues of radar and radiological equipment look like extracts from Charles Perrault or Walt Disney. It has been claimed that living communities organized around great research projects enjoy an increased marriage and birthrate.

And still enough fortitude is left over to withstand the sometimes enforced segregation, the official canteens, the collisions of inflamed egos, and a host of other evils which plague such working ensembles, some of which we shall consider later on.

In junior participants, parochial pride in their work may go so far as to endanger the balance of their outlook.[6] These extremes of overabsorption should be corrected by informal gatherings[7] which bring various ranks together; senior people with wider interests should endeavor to share them with their colleagues through the medium of lectures, leisure activities, and social occasions. Such continuous diffusion of interests throughout the community also helps to maintain that haziness of hierarchy whose necessity we have recognized above.

The Establishment and its Director

WE SHALL now turn to a description of the essential structural forms. Organized large-scale physical research takes place in "establish-

[5] Bernal, *op. cit.*, p. 429.

[6] Cf. the anecdote related by Crowther and Whiddington (*op. cit.*, p. 84): one young radar worker said to another, "What is this physics of which we hear so much?" to which the other answered: "I believe it is part of radar."

[7] Cf. the "Sunday Soviets" of the British Telecommunications Research Establishment at Malvern, (*ibid.*, p. 85).

ments," of which a few outstanding examples are in everybody's mind, such as Berkeley, Los Alamos, Harwell, and Eindhoven.

The present-day idea of an establishment is something subtly different from the older conception of a "research institute," which often meant little more than a few researchers or research teams dwelling under a common roof and bringing their manuscripts to the same typist. Nowadays, organized research requires the participation of many disciplines: a single project may involve at the same time electronics, thermodynamics, vacuum technique, chemistry, biology, and mathematical theory. Concentration of all these diverse activities in a single building or on a single piece of ground may be a matter of administrative convenience or may become an intrinsic necessity when, for instance, the research project is built around a waterfall or a telescope.

All the essential common services—workshops, information, canteen, often lodgings—must be within easy reach; once it has recognized itself as a sovereign unit, the establishment tends to achieve self-sufficiency and to acquire a self-contained territory. This latter characteristic is not essential: a true organic unity is often achieved between research facilities situated many miles apart. It is possible to imagine a single establishment using the resources of, say, Stockholm and Uppsala. The Dutch cyclotron project is, to some extent, shared between Amsterdam and Eindhoven. In these cases a leading personality can easily make his presence felt in all parts of the project within a single week. It would be much more difficult to ensure an effective unity of direction over a distance comparable to that between Paris and Lyons, or Oxford and Glasgow. Such difficulties may be solved in the future by the use of private planes, but, for the time being, the geographical limitations are all too obvious.

WITHIN these limits, the size of the establishment must be appropriate to its aim. If we want to provide it with every desirable facility, and if every participating discipline is to be adequately manned by qualified specialists, the establishment must be given a certain minimum, or "critical," size, below which it could not hope to tackle the problem with any prospect of success.

If the task is big and intricate enough, we may find that the resources of a whole nation fall short of this critical size. For example, as I have stated elsewhere,[8] the task of building a self-sustaining nuclear reactor seemed at the time of writing, to be beyond the possibilities of most European nations taken singly. If several nations decide to combine and form a cooperative establishment dedicated to some such aim, the geographical limitations discussed above will force them to evolve some hitherto unknown forms of international collaboration.

On the other hand, it is easy to imagine an establishment which has been made, or allowed to become, so big that a single directing personality cannot maintain an effective link among all its parts.

AN UNFAILING danger sign is the spread of internal bureaucracy; another[9] is the appearance of cliques. It is interesting to note that less than ten years ago Bernal estimated the desirable size of an "institute" at "something between five and fifty qualified workers," whereas today Chatillon with a little over one hundred graduates appears rather small, and Chalk River and Harwell with their several hundreds do not seem overgrown.

This change of scale is a novelty; the desirable size seems now to range between a few dozen and a few hundred "qualified workers" or "graduates" (this broad definition would include lower-grade university degrees such as the French licence or the British B.A., the engineering diplomas from technical schools and faculties not necessarily of the Zurich or M.I.T. standing, and occasionally some talented autodidacts).

Because every large-scale establishment involves many diverse fields of activity and expert knowledge, and has to be animated by a common spirit, the necessity for a single unifying personality at its head is even more obvious than it was in the older type of research institute. It is difficult to imagine an establishment without a director who embodies the common aim, and fosters every contributing discipline without allowing it to become an end in itself.

A good director "must not do anything himself"; he must be able to delegate almost any single question to an appropriate member of his staff; but, since his decisions have to intervene in every field of activity represented in the establishment, he must endeavor to acquire an overview which avoids any narrow specialization. It is sometimes difficult for a man full of drive and bent on some sharply defined task to achieve this dilution of interest; the best directors, therefore, are not likely to be found among the pure "men of action."

Some of the best-known directors have had notoriously diversified careers, oscillating between engineering, pure science, teaching, and civil administration (Joliot-Curie, Cockcroft); others are renowned for the extremely wide range of their interests (Oppenheimer). The aptitude for, and past practice of, pure scientific research on academic lines seems to be indispensable, even if the research project is of a predominantly "applied" character.

Strong practical men put in charge of such projects have often ended as complete failures (for obvious reasons I shall cite no names); on the other hand the unexpected practical sense of such "longhairs" as DuBridge, or the military ability of the British Operational Researchers won quick recognition even in prejudiced quarters.

The ability to produce work without knowing exactly what one is actually doing or intending to do, is, as I have already stated, essential to the success of any research activity, and it seems that, so far, academic science has provided the only effective training ground for this particular ability. The scientifically trained mind, more than any other, seems to be capable of responding quickly to a changing situation: let me quote as an example, the introduction of centimeter radar waves in the midst of the war, largely owing to the influence of an academic physicist, Dee.

IT GOES almost without saying that the director must be a skilled practical psychologist. He may have to exercise this craft in "man-to-man" conversations with wayward members of his staff, but more often he will have to show it in public, at the periodic meetings of the division heads' council. This body, under various names, seems to be a necessary feature of all large-scale research projects. It throws together strong personalities whose interests and ambitions, linked though they are by the common aim, do not overlap, and often contradict one another when viewed at a close range. The director will thus have to preside over long meetings devoted to mutual information, griping, and airing of petty conflicts. He may have to arbitrate and to take single-handed decisions, sometimes against the expressed majority.

[8] L. Kowarski, "Atomic Energy Developments in France," *Bulletin*, IV (May, 1948).

[9] See Bernal, *op. cit.*, p. 266.

The council is not a voting body, since its members are in no sense elected representatives of any citizenry; the indispensable democracy of the establishment, as far as it needs formal elective representation, has to get it through other channels.

It might be remarked that the identification of the spirit of an establishment with the personality of its director should not be carried out too closely, if only because even the most gifted individuals do not last for very long on the time scale of an institution. The answer is that, as institutions go, big research establishments seem to be rather short-lived, at least in their conspicuously productive phases.

In their history, a life cycle may be discerned: the childhood of an establishment is characterized by abnormal emphasis on administration, and especially on real estate and building activities; in adolescence the stress is on construction of apparatus and theoretical planning; mature age shows itself in full production; and in old age the establishment dissipates its substance in budding and swarming processes. Our experience of large-scale research has so far been too short to enable us to produce an estimate of the average duration of this life cycle; I venture to predict that a more extended observation will show it to be of the order of ten to twenty years. This estimate refers of course to average healthy specimens and includes neither exceptionally fruitful ventures nor misfits, some of which may far outlive their useful age and go on existing in a state of artificial and sterile preservation.

The personal touch, and the personal responsibility which goes with it, do not transcend, as a rule, the scale of a single establishment. Several establishments working on identical or neighboring problems can be coordinated, usually by a committee responsible to a Minister. There have been on record some vivid and forceful coordinators, of whom General Groves is the most obvious instance, unequalled in many other fields of applied research, such as radar.

Divisions

A DIVISION may be defined as a part of the establishment's staff and resources devoted to a single discipline or kind of activity and supervised *in all its essential details* by a single person responsible only to the director. This reference to personal supervision sets a natural limit to the possible size of a division. In fact, Bernal's size estimates, which, as we have seen, have been transcended by the recent growth of organized research, seem to hold if we apply them to divisions instead of establishments. He recommends five to fifty graduates and, on the average, one to five nongraduates per graduate according to the type of work.

Too big divisions, like too big establishments, tend to split in fact if not on paper; every forceful personality aspires to the status of a leader in his own chosen field, responsible to none but the director, and as a result of this disruptive pressure, the number of divisions in a great establishment tends to increase with time. The director must be constantly on guard against this tendency; in particular he must not allow the division heads' council to become too unwieldy. According to my personal estimate, the reasonable number of divisions is comprised between four and twelve.

A DIVISION is devoted to a discipline (such as chemistry or electronics) more often than to a definite goal (such as the building of a machine, or the development of a process). The necessity of putting the latter sort of activity under separate leadership often leads to the creation of a separate division which splits away from its main contributing discipline and tends to gather within itself autonomous representatives of several other disciplines, sometimes in direct rivalry with the divisions already in charge. Thus, for example, a division of mathematical physics may embark on the construction of an electronic computer, involving the employment of specialists in electronics and mechanical engineering. The inclusion of such specialists in the division of mathematical physics will be resented by other division heads as an act of trespassing on their own fields. This tension may be partly relieved by the creation of a new division.

A better solution consists in the establishment of close cooperation between the involved divisions and in the appointment of someone to take charge of this particular field of cooperation. With the creation of several such "projects" cutting across the "divisions," the hierarchy of the establishment assumes a two-dimensional pattern, in which the channels of tradition and logical subordination are at right angles with the channels of urgency and diplomacy.

The necessity and the feasibility of this new kind of hierarchy has not yet been fully recognized, and attempts to work according to this pattern often result in confusion of responsibilities and duplication of effort. I am not inclined, however, to regard either of these symptoms as an unmitigated evil. I have already mentioned the desirability of a certain haziness in the hierarchy; as to the duplication of effort, some amount of it is positively necessary in order to preserve that freshness and that diversity of approach which are so much more needed in scientific research than in other kinds of organized endeavor.

Turning our attention back to the older and more formal pattern of hierarchy, we have to notice that the division head must wield the power of hiring and firing; that every head should have a designated deputy who automatically takes charge of the division's day-to-day activities whenever the head is absent (the office of a deputy director is much more difficult to fill, nor is the need so imperative in view of the longer range of the director's preoccupations); that the task of selecting, appointing, and upholding suitable division heads is one of the cardinal responsibilities of the director; and that intellectual pre-eminence and creative ability are by no means the only essential requirements. (I would even risk the statement that a scientist of genius may sometimes turn out to be a rotten division head).

Many reasonably successful researchers, when they reach the age of forty or so, arrive at a stage where their experience can best be used in semi-administrative and coordinating tasks. By taking all cares of that nature off the shoulders of their younger or more narrowly specialized colleagues, they can greatly contribute to the over-all efficiency of their scientific community. Those who scorn "too much coordination, too little hard work" and declare that what was good enough for Faraday is good enough for them, do not seem to understand how much young and fully productive talent has been wasted in the past in clumsy struggles for the most elementary facilities.

THERE is little to be said about the internal structure of a division. According to the usual pattern, every sharply defined task is entrusted to a group leader, who often but not always is a graduate of some experience, and who may count among his subordinates a number of graduates ranging from one to ten or twelve depending on the nature of the task. In most cases the group leader should be a working scientist in his fully productive phase.

Every major change in the program of a division should result in a reshuffling of its groups; the new set of group leaders may be different from the previous one, and it is necessary to create among the persons involved a state of mind in which no undue importance is attached to such promotions and demotions.

Some reshuffling of personnel *between* divisions may, from time to time, prove beneficial as a means of promoting unity within the establishment as a whole. However, such shifts will seldom result in any major changes of the divisional framework.

This difference between the intra- and inter-divisional levels as regards the possibility and desirability of reshuffling, shows to what extent the average researcher at present is wedded to his subject or technique. Many warnings have been voiced since the turn of the century against increasing overspecialization. Recent experience seems to show that these fears have been, on the whole, exaggerated. However, some degree of irreversible specialization has become a fact to be considered, and that is why shifts of personnel from one division to another will be relatively rare.

IN THIS section I attempt to point out some distinctive features of the modern research organization, rather than to provide a handy recipe on how to set up this particular part of the establishment.

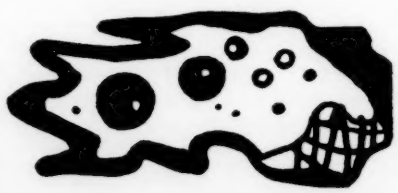
The *administration* has to solve the delicate problem of being at once sufficiently flexible to serve adequately the needs of a highly individualistic community, ruled by an intuitive and constantly changing schedule, and sufficiently firm and efficient in its purely administrative ways, to fulfil the task inside the establishment and to merit the confidence of those outside it. The concept of waste, in particular, requires a great amount of thoughtful adaptation in the mind of a professional administrator.

The *purchasing office* will let itself be guided by technical experts, of which there will be one in practically every division, attached to the division head rather than to the central administration. This technical decentralization, made necessary by the diversity and highly specialized nature of the supplies to be purchased, should not be allowed to disrupt the central office. Inasmuch as the aim to be served is urgent and important on a nationwide scale, speed in getting supplies is more essential than cheapness, and quality is paramount.

In these postwar years, constant contact with the supplier is needed in order to get good priority and to help him in ironing out unexpected delays. Among the purchasing staff there should be several energetic trouble-shooters well acquainted with the market and ready to make good use of that national goodwill without which the establishment cannot possibly prosper.

THE selection and hiring of personnel should be even more decentralized. There may come a time when a systematic reliance on selection tests will necessitate the creation of a central psychotechnical bureau in every establishment; for the time being, possibly owing in part to the still prevailing state of almost full employment, candidates for research jobs, both full-fledged and ancillary, are usually picked and judged by the good old-fashioned methods of interview, intuition, trial-and-error, and mild nepotism. This task is better left to division heads and their deputies, and the central administration should confine itself to the supervision and proper channeling of the chosen candidates.

I mention in passing such administrative activities as storekeeping, housing, and catering. There is more to be said about transportation. I can state without exaggeration that I have not yet seen a single big research organization provided with transportation facilities on a really adequate scale. Those responsible for it seem to underestimate both the modern possibilities (cars, buses, planes) which exist even in petrol-hungry countries such as Britain, and the special needs of a community which includes an unusual proportion of creative personalities, to whom the opportunities for contacts and for escape from contacts are almost equally important. Most of the specific features we have discussed above—the decentralization of authority, the need for quick reorientation of plans and designs, the necessity of cooperation with agencies and persons outside the establishment—concur in creating a demand for transportation far in excess of that encountered in nonscientific communities of similar size and structure. This demand affects the whole scale of communications, ranging from interoffice telephone to transoceanic travel.



The coordination between bodily transportation of brainpower and other forms of scientific communication falls within the province of the *department of information.* Evolved out of the time-honored functions of bibliography and documentation, the information service, far more than any other common service, has felt the impact of new development. At least two specific *negative* influences have been at work there: the long-prophesied and at last eventuated breakdown of the old network of scientific societies and journals, and the increase of secrecy. Instead of merely handling an incoming flow of periodicals and reprints, the up-to-date information office has to assume, on a restricted but fully autonomous scale, the following functions:

1. *Editing* the establishment's internal reports; *multiplication and distribution* of these reports and of documents from outside, using all the modern devices of copying, such as microfilming and varityping.

2. Interpretation and application of *secrecy regulations,* involving all the irksome and unpopular decisions as to who shall or shall not be allowed to see and possess a copy of this or that restricted document.

3. Organization of internal *seminar and lectures;* of inter-establishment (and sometimes international) *colloquia and conferences;* participation in such events taking place elsewhere; dispatching and reception of lecturers.

4. Contacts with information officers in other establishments; public and press relations; patent questions.

IT IS interesting to note that most of these activities emphasize the inadequacy of the printed and mailed word, and lay stress on word-of-mouth, the manuscript, and restricted copying. This somewhat reactionary tendency was partly imposed by the continuing deterioration of the pre-1914 framework of international civilization, and may be partly due to increasing recognition of one long-ignored characteristic of science as opposed to other organized activities in the modern world. The highest functions often are the slowest to mature, and it can be said that, with its guild structure and its sustained reluctance to recognize the fierce realities and limitations of the modern national

state, science has never discarded some of its initial features rooted in the medieval way of life, and could never fully adapt itself to abandoning certain handicraft practices.

Experience shows that, within this new definition, large-scale information offices have usually been very successful.[10] They have managed to record and spread the fruits of the collective thinking and creation as far as they could go without actually infringing the secrecy regulations; in doing so they helped to keep the interpretation of these regulations on a reasonably broad-minded level. The increased efficiency of communications *within* the formally permitted (and often elastically stretched) bounds went a long way to compensate for the hampering effects of secrecy *outside* these bounds and of its occasional inward encroachments.[11]

THE increase in size of research establishments, and the new orientation of their information offices, have not necessarily led to a corresponding centralization of the older functions of abstracting and card-indexing. It could be argued that a working scientist should never delegate this exploration of his chosen field to an impersonal office; every group should study the relevant original literature (and, of course, the abstracting periodicals), and the pooling of this task should hardly go beyond the divisional level.

In the common service of *instrument-making* there is a similar struggle between centralization and its opposite. The first tendency arises from the complexity of modern apparatus and its greater dependence on outside suppliers, stores of spare parts, and skilled servicing—as well as from that Will to Bureaucracy which unavoidably plagues all big organizations. The counteracting influence comes from old-established habits of scientific work, and is far from being entirely due to sheer inertia. The daily requirements of a working scientist are diverse and unpredictable; no central supplying organ constructed on industrial lines has yet succeeded in coping with them quickly and adequately.

In my own experience, this clash has always resulted in the spontaneous growth of "clandestine workshops" which many an active division head managed to foster against the opposition of those responsible for the central workshop of the establishment. Electronics, which is quickly becoming the hub of modern instrument-making, usually remained in the safe grasp of those who managed to keep up an awesome respect for its mysteries among their less-specialized colleagues; the older crafts of glass-blowing and vacuum have, on the contrary, tended toward complete decentralization. The present trend seems to be toward setting up a central instrument-making department, embodying all relevant crafts, and the continued existence of "clandestine activities" on the divisional level.

The worst we can fear from such a state of things is a certain amount of jostling and duplicated effort, and, as I have already stated, much is to be said for benevolent toleration of a certain amount of these necessary and sometimes useful evils.

The *department of applied mathematics* may, with some justification, be listed among the common services of the establishment. It may work in connection with the "theoretical division" if there is one; or with the information office. Up-to-date methods of computing, statistics, graph-drawing, and treatment of differential and integral equations, have become indispensable tools whose skilled users contribute to nearly every branch of modern research. While applied mathematics has thus gained much new influence, it has lost some of its esoteric prestige; getting off the pedestal and joining in the scuffle of the front-line advance may have created some psychological problems, but we may hopefully expect it to be welcomed by the rising generation of mathematicians.

Pathology

IN THIS last section I intend to bring solace to those active pioneers in the field whose ideals soar far above the realities of their working environment and whose sufferings are unnecessarily aggravated by the delusion that they are plagued with unique and unprecedented shortcomings. In the unsystematic and far more exhaustive list of diseases given below, the symptoms are described very briefly and no cure is suggested apart from a general reference to the previous sections.

Führerism. Individual responsibility for decisions and denial of executive capacity to such bodies as the division heads' or group leaders' councils may be carried too far and lead to a situation in which criticism is suppressed and information is withheld on the grounds that the executive should be given a free hand. It is doubtful whether such undemocratic practices pay in any walk of life; it is certain that in the field of organized research they lead to sterility and disaster.

Too much hierarchy. A very sharp identification of persons with various ranks of heads, leaders, deputies, permanent assistants, and so on, can breed a tendency to base thereon the automatic granting of various graded amenities such as access to a restricted document, or a more glamorous type of house. In such conditions the healthy ambition to enlarge one's scope of work or to secure due recognition for one's achievement may degenerate into a mere grabbing of titles and of the attached tidbits. Relations between chiefs and subordinates get sour, and cooperation between equals declines.

Too little overlapping. A perfect delimitation of all tasks and a painstaking elimination of all overlapping may lead to a situation in which nobody is allowed to tackle an unforeseen problem. For example, the development of a novel electronic device involving the use of a rare chemical may, in a chart-ridden research organism, become taboo to the electronics division because of the chemical aspect, and to the chemistry division because of the electronics.

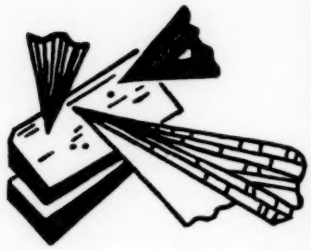
Happy sleep. This condition threatens to overtake autonomous divisions and dependencies, and sometimes whole establishments, if at some earlier stage they managed to enrol the support of the authorities and public opinion and, later on, removed themselves from all control exercised from outside. In the incipient phase of the disease the stricken community is still happily busy over some trivial or insoluble problem; at later stages grass is allowed to grow between the workshops and laboratories and the population may acquire an agricultural outlook.

Commanders vs. Creators. In modern big research organisms, high salaries, internal prestige, and arbitrary labeling (usually by the press) of a definite person as *the* inventor or discoverer of this or that, often concentrate on officers who command the biggest crowds of subordinates. Highly creative researchers often lack the ability to exercise such command with grace and efficiency; hence they tend to get discouraged or to scramble for unsuitable positions. The problem of how to grant "honorary ranks" to outstanding individual researchers, and how to distribute such privileges according to judgments

[10] Cf. J. D. Bernal, "Lesson of the War for Science," *Reports on Progress in Physics*, X (1946), 423.

[11] For a lucid discussion of secrecy in its relation to security, see L. N. Ridenour, "Military Security and the Atomic Bomb," *Fortune*, (November, 1945).

SCIENCE, MATERIALISM, AND THE HUMAN SPIRIT



It is often said that the Western World no longer possesses the sense of common values which gave coherence to human activities in earlier ages. The part played by science in producing this crisis, and the contribution it can make to a solution, are considered in the following four papers which were given at the Convocation of the Massachusetts Institute of Technology, held on April 1.

THE SCIENTIST'S COMMITMENT

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THE connotation of this juxtaposition of words, with their background of usage in our modern society, is not, I think, altogether a pleasant one. In certain circles, at least, science is regarded as devoid of emotional elements, coldly logical, and completely materialistic, while materialism is a term of opprobrium for a brand of philosophy which sees nothing beyond the world of the senses and is callously indifferent to the higher things of the spirit. Since science is coming to play such a large role in modern life, it is important to examine the justification for this widespread feeling that science is in some way inimical to a realization by man of the highest within him.

Such an examination demands in the first place a clear understanding of the meaning of the terms "science" and "materialism." "Human spirit" might perhaps be thought to be most in need of definition, but I think a certain vagueness is tolerable here. We can get along with the negative qualification that I shall not use "human spirit" with any extra-natural connotation, and in particular do not imply the existence of a soul in the sense of the theologian or make any commitments with regard to a future life. But "science" requires clarification because we shall be concerned with a wider range of human activity than is often covered by the accepted usage of "scientific." This is often restricted to imply the physical and biological sciences, whereas we shall want to cover psychology and the social sciences. More generally, I shall want to cover in this discussion all those activities to which the word "intelligent" is applicable, regarding science as only a special case of the exercise of intelligence in special fields. Some may want to use intelligence with a wider connotation than I shall employ here; my use of it in the sense that intelligence becomes identical with science in certain fields sufficiently indicates the sort of restriction I have in mind. Perhaps it would be better to qualify it by saying "natural intelligence." Some people, for example, might say that conscience as the voice of God is a form of intelligence; it is usage like this that I am trying to avoid.

Turning now to "materialism," this has had a special implication in traditional usage and originally was associated with a mechanical theory of the construction of the universe. At one time materialism involved a very special mechanical hypothesis, namely that the universe could be explained in terms of the actions on each other of particles endowed with mass and exerting forces on each other which were knowable and which presumably in the last analysis could be reduced to inverse square forces. This special thesis was abandoned when the significance of the electromagnetic field equations was properly appreciated, and was presently replaced by the less restrictive thesis that the explanation of the universe could be reduced to the action on each other of particles and their fields of force. Even this more general picture is now superseded with the advent of the Heisenberg principle of indetermination and other more recent developments, so that I doubt whether a physicist today would know whether the epithet "materialistic" was properly applicable to his subject or not. We might therefore, if we were captious, take the position that materialism is a dead issue and refuse to discuss our proposed topic. But it seems to me that there was indeed a point of view underlying the old science-materialism dualism which survives and inspires present-day science, and it is to this transformed older idea in its present dress that I would like to direct attention.

It seems to me that what survives from the old point of view is the resolve by scientists and by many other people of intelligence to carry through to the utmost the program of dealing with the universe by the methods of intelligence alone, without resorting to methods which might be roughly described as mystical or supernatural. I think it will be agreed that scientists as scientists are committed to carrying through such a program. I propose as the question for our examination to find what the implications and the reactions of such a commitment by the scientist are on the human spirit. Is the human spirit restricted by such a commitment, and, if so, are the restrictions onerous or degrading? I shall discuss this under two headings: In the first place, what are the demands made on the human spirit in accepting such a commitment, and, in the second place, what are the reactions on the human spirit from carrying through the commitment to the extent which present-day science has carried it?

Acceptance of the commitment to exclusive use of the methods of intelligence is itself an act of intelligence. For we are not here concerned with the acceptance of arbitrary limitations for their own sake, as when one composes a cross-word puzzle on a pattern

The Proceedings of the M I T Convocation, including not only the formal papers, but the discussions as well, will be published in book form by the Technology Press of the Massachusetts Institute of Technology, in the autumn.

of his own creation. We accept the commitment to the use of the methods of intelligence because that seems to us from all the evidence at present in hand to be the only method which has any prospect of successfully accomplishing the purpose of the scientist, which may be broadly described as understanding. The judgment that this is the only method has come from a detailed examination of all the evidence in that spirit of impersonal detachment which is usually described as "scientific." This is not the place for argument as to the validity of the conclusion, but for our present purposes we take this conclusion as given. In reaching this conclusion we have not allowed ourselves to be influenced by what it might be pleasant to believe, but have subjected ourselves voluntarily to a single supreme control, the control of agreement with the facts. In the face of a fact there is only one possible course of action for the scientist, namely acceptance, no matter how much the fact may be at variance with his anticipations, and no matter what havoc it may wreak on his carefully thought out theories. In the face of the fact, the scientist has a humility almost religious.

THE commitment of the scientist to the program of intelligence does not involve a blind commitment to a special "belief" about the structure of the universe, nor does it constitute an act of "faith" on his part, although it is often stated that the scientist, as well as the mystic, cannot get along without his articles of faith, in this case faith in the existence of uniform laws in nature. It seems to me that for the scientist faith can be no virtue, because it is inconsistent with the resolution to accept the fact as supreme. If it is accepted that the object of the scientist is to discover the laws of nature, as is often stated, it is perhaps justifiable to claim that the scientist, by the very form of this formulation, proclaims his belief that there are laws of nature before they have been established, and that this belief without adequate evidence is by definition an act of faith. But the scientist cannot commit himself in advance of the evidence even to the thesis that nature has laws. A more careful formulation of an objective of science is that it is to discover in nature those regularities which exist, with certainly no commitment as to how far these regularities will be found to extend.

IT SEEMS to me that the exercise of faith is mostly a psychological device which makes it easier to carry through a program of action without continually reminding oneself that the program was adopted only because it was the program which seemed to have the greatest probability of success, or even indeed because it was the only program which was at all possible in the circumstances. It seems to require an unusual fortitude to be able to carry through a program in the clear-eyed recognition that we are doing it because some action is necessary and there is nothing else to do, without help from the belief that we shall be successful. Many of the situations of daily life are of this character, and faith has survival value in enabling us to carry on. But this need not restrain us from analyzing what faith involves or from realizing that faith is not for the scientist when he is pushing his analysis as far as possible and making his analysis as articulate as possible. Neither do I think that when he has made the analysis he will feel a sense of spiritual loss in his inability to perform acts of faith in the conventional sense, but will rather have a feeling of spiritual attainment in that he has made a step forward in his adjustment to things as they are.

THE resolution to accept the fact as the supreme arbiter is not necessary. We might prefer, as does the mystic, to live in the world of fact only in so far as we are compelled by physical necessity, and to live as much as possible in a world of our own free construction. It is true that the mystic, in so doing, runs the risk of encountering certain practical inconveniences. I believe, however, that the refusal of the scientist to follow the mystic, and his resolution to submit himself to the discipline of the actual, is founded on something much deeper than considerations of convenience, and involves emotional components and value judgments which touch the human spirit. The scientist finds something abhorrent and unclean in a willingness to live in a constructed world. For this feeling, no completely rational justification is possible. Although no rational justification can be found, it is nevertheless possible to analyze out several components which make more understandable the willingness of the man of science to submit himself to this discipline.

There is in the first place the intellectual challenge of the problem of adapting oneself to the external world and finding the explanation of it. This problem is enormously more difficult than the problem of constructing a world in which one may live by oneself. The joy which every true scientist feels in accepting the challenge of difficulty is, I think, not without spiritual elements. Then there is the consciousness of integrity which is the gift of the intellectual honesty that dares to discover the correct answer irrespective of personal discomfort. This consciousness of integrity abides with the scientist and is, I think, one of his most precious compensations.

FINALLY, by voluntarily making himself the complete slave of the fact, the scientist has at the same stroke won complete freedom for himself in all other respects. For if the fact is to be supreme, there must be no limitations on the methods by which facts are discovered, but there must be complete freedom, unfettered by extraneous considerations of any sort. There are here obviously two freedoms, an inner freedom and an outer freedom. Maximum efficiency in the output of the scientist demands that he have as much outer freedom as possible. This outer freedom comes from society; it may involve financial support and support by public opinion, or it may be denied by political compulsion. But however society may be able to control the outer freedom of the scientist, it is powerless to touch the inner freedom of his thoughts. Once he has seen the vision, the consciousness of inner freedom abides with him, a companion of the consciousness of integrity, and is no less his solace and his strength. For him, the words of the scripture take on vital meaning, "The truth shall make you free."

HAVING examined some of the spiritual implications of the commitment of the scientist to his program, we turn to a consideration of some of the consequences of the new insights which have been acquired in carrying out the program thus far. I believe that the most important aspects of these new insights are connected with a realization of man's true intellectual position in the world, and it is to these that I shall confine my attention.

One of the new insights is a growing realization of the importance of semantics to our whole intellectual enterprise. The origin of this realization was in the experience of physics with the theory of relativity, but the full sweep of the

(Continued on page 196)

THE AFFINITIES OF SCIENCE WITH MORALITY AND RELIGION

Julius S. Bixler

President of Colby College

THE question has been asked whether there is any basis for continued common action at the highest spiritual level. For me there is only one answer. We have such a basis and to see what it is we have only to draw the implications of what we are already doing. The fact that we have not done what we know is right does not, after all, prove that what we believe to be right is itself wrong.

It is clear that we have failed to live up to what we profess. It is also clear that we are on the point of losing our nerve. Today we stand in special danger of underrating thought and its power. What we call "reason" and "mind" are on the defensive. The constant attack on the so-called "liberal-optimistic" view is one evidence. In many areas of life the arts of persuasion are yielding to the insistent pressures of violent compulsion as a means of deciding issues. The cult of the "daemonic" in contemporary theology, the use of distortion in modern art, and the retreat into the unconscious in present-day literature all indicate a growing suspicion that mind cannot face up to and solve the problems of life today. Inevitably science is summoned before the bar of judgment and is labeled a false messiah which has not brought the salvation it promised.

At least part of the trouble has come from our inability to understand what our intellectual methods imply and what they can be expected to do. Of course there is a sense in which science has failed to show the positive moral influence that was expected of it fifty years ago. Its body of knowledge is neutral. It will hire out to any master, and its results can be used for evil purposes as well as good. Yet there is also a sense in which, as a method of inquiry and as an activity carried on in accordance with standards that are valid above the plane of utility, it is neither evil nor neutral but an expression of spiritual idealism. It presents us with ethical demands and with a basis for a continued common action on a level that is very high.

Opposed to what is claimed by many today, and especially by some of the most eloquent writers in the theological camp, I think it is important to remember that there can be no sharp break between our intellectual and our other activities. Wherever thought is relevant its standards of consistency reign supreme, and we should not forget that its relevance is very nearly all-pervasive. It is true that parts of our experience are nonrational in the sense that our concern with their emotional content is not analytical and that we do not expect them to aid us in the search for factual truth or to submit to the tests this search requires. Our interest in art, for example, is not based on its power to throw light on the nature of the physical world. Nor should we expect religion to be a substitute either for geology or for history. But none of our experiences should be irrational in the sense of forcing us to adopt attitudes or beliefs that run counter to what our intellectual standards of consistency demand. It may well be that our religious faith operates partly in a realm where scientific tests do not apply. But if this is so, we must be clear in our own minds where and why they do not apply, and if we leave them behind we must know where to pick them up again. The standards of consistency by which reason works must never be lost sight of, and, when knowledge or true belief are in question, they must always be employed. Psychologically, if not politically, we live in one world. On no other assumption can we keep our mental health or prepare ourselves for the colossal tasks that confront us.

This leads to the belief that we should be more careful in the distinctions we draw within the intellectual life. As we have seen, science falls naturally into two parts—a body of knowledge and a method of inquiry. Often we talk today as though we were afraid of science. What we are actually afraid of, however, is the towering, mushroom-shaped body of accumulated fact which can so easily blast all our hopes to nothingness if used for the wrong purpose. Science as fact is neutral, with great possibilities for evil looming up behind its neutrality. As a method of inquiry, however, it can only be regarded as on the side of the angels and as offering a positive basis for hope.

From its method there are at least three spiritual lessons to be learned. The first is the need for integrity. Even the humblest scientific worker can hardly fail to see how futile is evasion or pretense. "Be sure your sin will find you out!" might well be inscribed over the laboratory door. If you try to fool the public, or even yourself, science tells us in effect, you may get away with it for a while, but sooner or later others in the field will catch up with you and the journals will expose your shame for all to see. Utter honesty is required in facing the facts and complete candor in weaving them into a consistent web. In science wishful thinking is exposed as the enemy of maturity it actually is.

In the second place, science is prepared to teach us the lesson that we seem to find hardest to learn—that is, how to cooperate. What activity in history offers a more striking illustration both of the need for agreement and of the ways in which it can be found? In the realm of science no man lives to himself alone. Not only does he build on the work of others. His own results must be checked and confirmed many times over before they can be accepted. Prejudice has to be eliminated. The scientific laborer must free himself of provincialism and must be ready to enter into the state of mind and accept the premises of his colleague no matter how far apart the two may be in temperament or in location. Science is the one discipline where disagreement simply cannot be tolerated. In its world differences of opinion mean inadequacy. Presuppositions must be brought out into the open. Assumptions must be examined and criticized. For the scientist the truth lies in what is shared and disparity in belief or idea exists only to be overcome.

In the third place, science introduces us to what we can only call the Kingdom of Ends in themselves and so brings us at least to the threshold of

religion. Thomas Henry Huxley described the attitude of complete humility before that which has a right to claim the last measure of devotion when he wrote to Charles Kingsley: "Sit down before fact as a little child, be prepared to give up every preconceived notion, follow humbly wherever and to whatever abysses nature leads, or you shall learn nothing." Here, as it seems to me, we face the distinction the philosopher often makes between the instrumental and the intrinsic value, between that which is important because of some use we wish to make of it and that which lays a claim on us for what it is in itself.

IF WE ask why we seek the truth I think we find two answers. We seek it because we want to use it, and we also seek it because as truth it ought to be sought. The case is like that of justice which is an ideal that we honor simply because it is justice and not because it is useful or pleasant. Is it not a fact that an exclusive concern with the usefulness of truth is characteristic of the earlier years either of the individual or of society? For the child and also for primitive man truth is important merely for what can immediately be obtained through it. But the mature mind sees it as important also for another reason. Often a boy comes to college with the idea that the truth is something to be used for his immediate uncriticized purposes of the moment. Sometimes that same boy awakens in college to the purposes the truth has for him. When that occurs education has really done its job!

In a memorable passage in the *Meno*, Plato makes Socrates exclaim: "Some things I have said of which I am not altogether confident. But that we shall be better and braver and less helpless if we think we ought to inquire, than we should have been if we indulged in the idle fancy that there was no knowing and no use seeking to know what we do not know—that is a theme upon which I am ready to fight, in word and deed, to the utmost of my power." You cannot question my right to inquire, Socrates here says in effect, because if you try to, you assume the same right for yourself. Freedom of inquiry is an unshakeable ideal, made so by the rules of the mind themselves. The claim laid on us by truth is irresistible. You cannot avoid it; you can only submit to it humbly, as Huxley said, and find spiritual strength in doing so.

HERE, as I see it, science and religion meet, and art and ethics meet with them. Science as an intellectual activity has developed methods of inquiry which show the presence of an intrinsic value, a goal with its own inherent reasonableness, an end which does not point beyond itself for its justification. Religion is our response to just such an end. God, whatever else he may be, is a God whose claim on us is that of the value we cannot question. The claim is seen most clearly in the case of truth because of all our values it is truth whose demands are most sharply defined and inescapable. But the standards and methods of coherence which we find in the search for truth have only to be extended and adapted to new material to apply in ethics and in art. Justice, as Plato taught, is the health of the state, or the coherent and integrated working of its parts. Beauty, in spite of the distortions and cacophonies to which the modern eye and ear are exposed, depends finally on a balance, rhythm and harmony in which mind and heart alike can find the peace that only wholeness brings.

Instead of losing faith in science should we not, then, recover its religious implications? Instead of either making merry or growing bitter over the futilities of reason, should we not try to see more clearly what it requires? As Professor Whitehead has reminded us, whereas Ulysses shared his reason with the foxes, Plato shared his with the gods. Reason presents us with the fact of a claim made upon human life. It takes us into the presence of that which we worship and obey. In doing so it lifts us above the fragmentary attitudes and beliefs by which we are kept from realizing our basic unity as men. We know that our world cannot much longer continue half slave and half free, half rubble and half skyscraper, half starved and half surfeited. We begin to have grave doubts whether it can continue half democratic and half totalitarian. A house divided against itself cannot stand, and a world which indulges too long in the pleasures of competitive struggle cannot endure. Whatever clues we can find to that which is valid above the competitive plane should be followed with all energy. Whatever steps our own limited and faltering reason can help us to take toward what is broad, humane, and universal should be encouraged with all enthusiasm.

Science, we have indicated, is not merely science. Under one aspect it is morality; under another it takes us to the threshold of religion. This is of course not to say that morality and religion are merely science themselves. They contain many other ranges of experience which bring diverse attitudes into play. But between science and the others there can be no contradiction. The relations of the various fields must be supplementary. This leads us to ask whether as a practical measure we should not pay more attention to what so many of our leading scientists are today urging on us and should not force education to break down the lines of departmentalization it has allowed to grow up. Instead of merely biology, physics, and chemistry, we have today biophysics and physical chemistry. Similarly in the social sciences, instead of economics, government, psychology, and sociology, we have concepts that refuse to fit into the accustomed grooves.

THE truly creative ideas come today from those who have by-passed the barriers between the individual disciplines and who, in addition to their mastery of one field of specialization, have been able to get the over-all view. One of our great tasks appears to be that of encouraging all efforts at synthesis in the learning process. Not only should there be no boundaries within the divisions of physical science and social science, but the walls between these two great fields must themselves be torn down. When we enter the laboratory, the door that leads to the marketplace must not be permanently closed. Professor Whitehead, to quote him again, has left us in no doubt where he stood on this important issue. "The increasing departmentalization of universities during the past hundred years," he said, "—however necessary for administrative purposes—has tended to trivialize the mentality of the teaching profession."

The main thing then, is that we should keep our nerve, and, as a means to this, we should not allow ourselves to think that our ethical situation is essentially new. It is true that some of our inconsistencies are exposed more sharply than before. The results of greed and ignorance are more painfully apparent to us than they were to our forebears. The abuse of our knowledge for acquisitive and competitive purposes stands out more clearly as the dangerous evil it is. But the present crisis

may help us to see the whole-making and cooperative instincts which are also part of our human heritage. The atomic age need not be an atomistic age. It is a fact that we are confronted with problems that seem terrifyingly new. But the laws of nature with which we must deal are the same laws we have always known, and it is against their background that human life has always been lived.

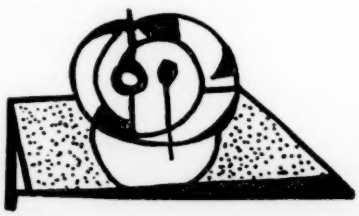
We should remember that the scientists and we ourselves are but parts of the same human race which with trial and error, but also with some success, has traveled the path of knowledge to the point where it now has a surprising degree of control over the physical world. In spite of failure and backsliding we have also succeeded in defining free inquiry as a goal in the world of the spirit and have developed habits of work and thought where the implications of this goal are being worked out. Difficult as are the times in which we live, and menacing as are some of the conditions that confront us, let us not forget that our heritage includes high achievement. Men have always set before themselves aims that are worth while. Some—let us thank God—have been realized. Institutions of learning have been established and maintained often in the midst of difficulties that appeared insuperable. Through persevering effort laboratories and workshops have unveiled many of the secrets that for centuries were hidden. We are ready now to reap the fruits of thousands of years of labor and we cannot believe that our own generation or those that follow will fail to see the job through.

Knowledge, said Francis Bacon, means power. Knowledge rightly treated can also mean insight. Separated from questions of worth and value knowledge remains deficient; but united with them it reveals our highest good. Immanuel Kant has borne witness to his own growth toward this idea in the following passage: "I am," said Kant, "an investigator by inclination. I feel a great thirst for knowledge and impatient eagerness to advance, also satisfaction at each progressive step. There was a time when I thought that all this could constitute the honor of humanity and I despised the mob which knows nothing about it. Rousseau set me straight. This dazzling excellence vanishes. I learn to honor men, and would consider myself much less useful than common laborers if I did not believe that this purpose could give all the others a value—to establish the rights of humanity."

The Scientist's Commitment

(Continued from page 193)

implications is, I believe, not realized even yet. The paradoxes of relativity theory were found to be associated with imprecisions in the meanings of such common-sense words as mass and length and time. The tacit assumption of common sense that the intuitive uncritical meaning of these terms was adequate for describing nature was refuted by the discovery of unexpected experimental facts. When the meaning of such a term as length, for example, was made by Einstein precise enough to deal with the physical situation, it was found that the meaning was not unique, but multiple, and not consistent with a common-sense treatment. The physical world proves too complex to be dealt with by common sense. We are coming to see that the situation is similar in a much wider setting, as indeed it would be a miracle if it were not, considering the uncritical and haphazard way in which the whole apparatus of common-sense thinking has evolved. We see that many of the misunderstandings and failures of everyday human relations are to be laid to imprecisions in meanings. This is particularly true in the field of abstractions and of religion. For instance, the single concept of "truth" is not precise enough to do the work that we want to do with it. We have to recognize that there are different sorts of truth, such as theological truth and scientific truth, just as relativity theory forces us to recognize that optical length is not the same as tactual length. The experience of physics gives a vision of the possibility of eventually so clarifying meanings that all misunderstandings which arise from that source shall disappear as a cause of friction between men. But the task is obviously one of enormous difficulty and constitutes a challenge to the spirit of man. I believe that we have the techniques in hand for solving this problem, and that with adequate intellectual morale we shall find how to emancipate ourselves from the trammels of common sense and more effectively realize our potentialities.

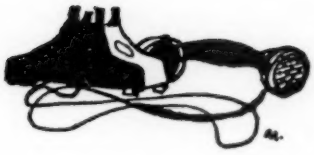


A SECOND vision which I believe is even more important than that of the role of semantics is given by a realization of the implications of the discovery of unsuspected physical structures in the direction of the very small and in the direction of the very large. In the direction of the very small, we enter a world in which the very concepts of identity and of recurrence are not applicable. Thought demands its permanent objects and its consciousness of recurrent situations; how shall we think about a world that has not these intellectual necessities? In the direction of the very large, more and more structure is being discovered by the astronomer, so that we have no right to maintain that the universe is not open. But the most sweeping generalizations that we have, energy and entropy, find their meaning only in terms of closed systems. How shall we think about a truly open system? And, in general, what meaning can we give to our most fundamental concepts, such as existence itself, in realms in which the necessary processes of thought fail?

The new vision that results from an apprehension of the significance of this is a vision of man isolated on an island of phenomena between the very large and the very small, which he cannot transcend because of the nature of thought and meaning themselves. It is an evident corollary that if man is to integrate himself, he must discover his springs of action within himself. This is a task which man has been effectively shirking since the beginning of conscious thought in his endeavor to find the solution by the invention of essences and cosmic purposes and absolutes. The acceptance by man of his essential intellectual limitation and isolation, which make meaningless his absolutes, will confer upon him a freedom similar to the freedom of the scientist in accepting the fact as his supreme arbiter. For it will free him of the consequences of attempting to do with his mind things which cannot be done because of the nature of thought itself, attempts which have cluttered his entire intellectual history.

There will emerge the vision that man is standing on the very threshold of his potential development, and that this can be attained only by breaking drastically with the past. It seems to me that education can have no more important function than to impart this vision. The challenge to the human spirit of a vision like this is too obvious to need elaboration; what the eventual unfolding of the spirit may bring, no man may venture to predict.

THE NEED FOR A SECULAR ETHIC



Walter T. Stace

Stuart Professor of Philosophy,
Princeton University

I SHALL speak in this paper about the modern age in our Western civilization; and by this I shall mean roughly the last three hundred years. The outstanding characteristic of this age is that all its thinking about the world is dominated by the scientific spirit. In this respect it is something wholly new, something unique in the world's history.

What has been the effect of this fact upon our general views of the nature of the universe, that is, upon our philosophies? I answer this question as follows. In all advanced cultures, except our own of the present day, we find the belief that *the world is a moral order*. Our culture, which once believed this too, is coming more and more to hold the opposite view, that the world is *not* a moral order. And this is directly due to the influence of science.

I must try to say what is meant by this idea of the world being, or not being, a moral order. Everyone knows that human beings often try to do what is right, to aim at what is good. The belief that the world is a moral order is the belief that this human characteristic can be anthropomorphically transferred to the non-human world, to the universe at large.

It appears in different civilizations in many different forms. Plato maintained that the universe aims at the form of the good. In Christianity, Judaism, and Islam, this supposed tendency of the world towards moral goodness is personified and called God. But the belief is not necessarily combined with theism. In Buddhism and Hinduism it appears as the law of Karma, which is the law that every soul in the end receives its just deserts, if not in this life then in another. Although in Buddhism there are gods, or at least great spirits, they are not the source of the law of Karma. They are themselves subject to it. The law is a quite impersonal law of the universe, like the law of gravitation. This may count as a nontheistic form of the belief that the world is a moral order. In one form or another men have generally believed that somehow the universe is ultimately just. And the common cliché, that "truth must prevail in the end," for which there seems little evidence, is perhaps just another expression of the view that the world is moral.

In our Western culture this ancient human belief seems to be breaking down. Though the opposite view that the world is not a moral order, may be rarely explicitly stated, it is the background of the modern mind. It is often expressed by saying that the universe is indifferent to our values. For instance, the constantly reiterated assertion that morality is a human thing, not a supernatural thing, implies this view. It is the common ground of all philosophies which style themselves "naturalistic." It is also at the bottom of the commonly stated opinion of anthropologists, sociologists, psychologists, and many philosophers, that moral codes express nothing but human emotions and are consequently variable and relative. Moral predicates are then called subjective, which is another way of saying that the objective non-human world is not a moral order.

How is science responsible for this revolutionary change of view? It is not that science *proves* that the world is not moral. Science as such is not concerned with values, and proves nothing of the sort. Nevertheless, as a matter of history, it is science which has *suggested* this view to the modern mind by its insistence on mechanistic categories. Everyone has heard of Newton's world-machine. This is now out-of-date science. But it is the science of the seventeenth century, not the twentieth, which has molded the modern mind. The world is like a clock, run by the laws of motion and the law of gravitation. Even if it is so, this does not prove that the world is not guided by a moral purpose. After all a clock, though it is a pure machine, carries out human purposes. But what happened was that the human mind, dazzled by the brilliant successes of science in explaining everything mechanically, saw no need for an additional teleological explanation. Since mechanical explanation seemed *completely* to account for the facts, there seemed no room left for teleological explanation, which was accordingly simply jostled unceremoniously out of the human mind. This was scarcely logical, but it has had its tremendous effect. If the world is not governed by purpose, it obviously cannot aim at a good purpose, in other words it is not a moral order.

ALTHOUGH such a view does not strictly follow from science, but is only suggested by science, I think we have, nevertheless, to accept it on other grounds. To suppose that the world aims, as some human beings do, at noble ends, is plainly anthropomorphic. And perhaps the chief ground for refusing to admit purpose in nature is just that there is no evidence of it. The supposed evidences of design in the world turn out to be fallacious. And the phenomena of mysticism, of religious experience, and the like, prove nothing. Of course this is no more than a dogmatic statement of my own opinion, but I cannot be expected to give reasons for it in a fifteen-minute paper.

But this situation, although we have to accept it, has had, and is having, very disturbing results. I am convinced that it is at the bottom of the moral chaos in the modern world. The point is that morality was supposed formerly to have religious, or at any rate metaphysical, foundations. These foundations have disappeared, for this is the meaning of saying that the world outside us is not a moral order; that morality is not founded in God, or in the universe; that it is not objective, but subjective; that it is merely human. The result is that moral values, having lost their traditional foundations, are crumbling. From the premise that morality is human the conclusion is drawn—wrongly as I think—that morality is merely relative, that what is right for one culture is wrong for another and therefore that there is no objective difference between right and wrong. The popular doctrine of the relativity of morals is merely a way of saying that morality has no foundation at all. This, translated from theory into action, is the creed of the

Hitlers and the Mussolinis and perhaps the Stalins, who have destroyed or are destroying international morals.

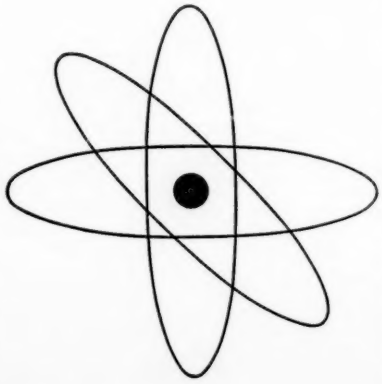
If this is the correct diagnosis of our disease, the direction in which we should attempt to find a cure is plain. The task of thought in our time is to replace the lost religious and metaphysical foundation of morals by a secular and naturalistic foundation. And I do not believe that this is an impossibility, or even a very difficult task. I will explain why.

IS THERE not an obvious mistake in the thinking which has led us into this impasse? We have argued that if values are not based in the non-human world outside us, then they are not objective; they are just human and subjective. And this has seemed to us to mean that they are baseless. But why should they be baseless because they are founded in human, rather than non-human, nature? Is not human nature an objective reality? There are truths about human personality—they may be called psychological truths—just as truly as there are physical truths. There are, for instance, the laws of the association of thought, nowadays called laws of conditioning. These psychological laws or principles are just as objective as the laws of physics.

NOW my contention is that what we call moral principles are simple principles of human personality, psychological laws, and are therefore perfectly objective. I think that the great moralists, such as Christ, Buddha, Confucius, were geniuses who discovered some of these principles. For instance, just as the scientists discovered that passing an electric current through water produced hydrogen and oxygen, just as some agriculturist discovered that fertilizers produce larger and healthier plants, so the moralists discovered that such things as malice and hatred if widespread in human societies tend to produce misery, while such things as love, affection, and unselfishness tend to produce joy, happiness, welfare, and the like. Why is this principle branded as "subjective," while the principle that fertilizers produce healthy plants is admittedly objective? Apparently the root of this fallacy is a semantic confusion about the words "subjective" and "objective." Psychological laws may be called subjective in the sense that the area in which they hold true is the area of "subjects," that is minds, not objects. They are truths about minds, not about objects of minds. But truths about minds are just as objectively true as truths about anything else. Emotions are subjective, but psychological laws or statements about emotions, if they are true, are objective truths.

Thus there is no difference in objectivity between the botanical statement that fertilizers tend to produce healthy plants and the psychological statement that malice and hate tend to produce unhappy human beings, love and affection happy ones. Nor is there in principle any difference as regards empirical verifiability. Both the results produced by fertilizers and the results produced by malice or love are known in the same way—by observing the facts. And just as when an agriculturist says "Fertilize your plants," his advice has a solid foundation in known facts about plants, so when the moralist says "Love your neighbor," his advice has a solid foundation in known facts about human beings.

Miss Ruth Benedict tells us that the Dobu Islanders disagree with this advice of Jesus Christ. They found their culture on treachery and ill will. They act as if they supposed that treachery and ill will are likely to produce the sort of society in which they will be most happy. Miss Benedict seems to conclude that treachery and ill will *are*, for the Dobu Islanders, good. My own conclusion is that the Dobu Islanders are simply mistaken. They would find, if they could be induced to try, that good faith and good will would produce in their society a much happier state of affairs for them than exists at present. People are often mistaken about what is good for the health of their bodies. That is why we have doctors. And people are just as likely to be mistaken about what will be good for the happiness of their souls. That is why we have moralists. The Dobu Islanders need someone to correct their moral or sociological mistakes.



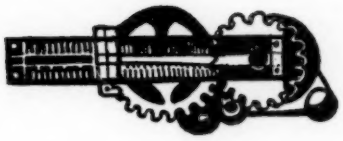
IT SEEMS hardly necessary to give other examples. It is surely obvious that, in general terms, dishonesty, breach of faith, lying, uncontrolled passions of any sort—the sort of things we call morally "bad"—tend to produce in a society conditions which we do not want; while their opposites, which we call morally good, tend to produce the harmonious conditions of society which we desire. These statements are, of course, very imprecise. But they are generalizations from experience, genuine inductions, and therefore—like scientific laws—objective and empirically verifiable. Thus there is no difficulty in principle in seeing that morality has already a good and sure secular, naturalistic, and non-metaphysical foundation.

I have compared moral laws to scientific principles. In respect of objectivity they are entirely comparable, but in respect of precision, of course, they are not. Love and hate are vague concepts and they can never be reduced to mathematical equations. But love and hate are just as real and objective as oxygen and hydrogen; and they just as truly produce effects in the world. And to know these effects is just as much knowledge although it may never be capable of the precision of mathematics and physics.

Also we know much less about the laws of personality than we do about the laws of physics. This means that our moral knowledge, the knowledge of what is good and bad in the conditions and relationships of human beings, is very elementary. But this is no reason for declaring that what knowledge we have is baseless. What we have to do is to advance in this knowledge.

To sum up. My thesis is that morals were formerly believed to have supernatural or metaphysical foundations. This belief is disappearing, so that morals seem now to have no foundation. This has produced a crisis in the human spirit, a loss of moral faith. But this is all based on a mistake. Morals have a perfectly firm and objective foundation in human personality. If men can be brought to understand this, then moral faith may be restored. The problem is really one of education.

SCIENCE AND ONTOLOGY



Jacques Maritain

Professor of Philosophy, Princeton University; formerly French Ambassador to the Holy See.

IT IS a fact that the Western World's consciousness is deeply troubled and divided. Obviously there is a problem: the crisis is first intellectual; its main symptom in this regard is not so much dogmatic materialism as that kind of abdication of reason which makes man unable to believe in anything but facts and figures and sense-data. And the crisis is also moral—hence an incapacity for "continued common action at the highest levels of the human spirit."

I would say, as a preliminary remark, that the problem we are facing, and which deals with the role of science and technology, is twofold. It has to be examined in two different perspectives.

The first perspective is the perspective of the intrinsic truth of the matter. Here we are concerned with a *philosophical* issue.

The second perspective is the perspective of the historical state of our civilization, and of our human possibilities for recovery. Let us say that the issue we are facing then is a *social* issue.

The two issues just mentioned should not be confused. It might be possible, after all, that men become one day intellectually and morally bewildered beyond repair. Such a negative solution to the *social* issue would by no means change the realities that the *philosophical* issue has to take into account. What is true would remain true, what is false would remain false, even if the majority of men became unable to grasp it.

THE philosophical issue is both speculative and moral. In the speculative field:

1. There are two typically different noetic approaches to reality: the *empiriological* and the *ontological* approach. The *empiriological* approach tends somehow to the epistemological ideal described by Logical Positivism. Concepts and definitions are resolved in the observable and measureable as such, that is, in the last analysis, in sense data (sense readings of measuring instruments) upon which a system of signs and symbols, especially mathematical entities, is to be built. The explanatory value of that system depends on the verification of its conclusions by experience. Any judgment has meaning only to the extent that it refers to sense observation and expresses the experimental ways through which it can be verified.

On the contrary, in the ontological approach, concepts and definitions are resolved in being, and express intelligible objects that abstractive visualization brings out from experience. The truth of the assertions thus established rests in the last analysis on basic intellectual intuitions, especially the first self-evident principles.

2. The empiriological approach is peculiar to science. Scientific theories deal with the observable and measurable as such, not with being itself.

The ontological approach is peculiar to philosophy and metaphysics. They deal with being and the intelligible structure of things, not with the mathematical or experimental explanation of phenomena.

Through quite other ways, religious faith also looks at things in an ontological (or even supra-ontological) perspective.

Because science is at work on a specifically different plane of knowledge, science, while progressing *ad infinitum* in the knowledge of things, will never propose any answer or pose any question dealing with the specific object with which ontological knowledge is concerned.

3. Science and technology, considered in their very natures, are by no means responsible for the intellectual crisis of our time. They accomplish in their own sphere their specific task, which not only practically and as to the mastery over nature but also speculatively and as to the knowledge of truth, gives testimony to the greatness of the human spirit. Neither does that task impair the workings of the human spirit in its other domains, nor entail by itself any kind of materialism.

4. What is responsible for the crisis is the impact of the prodigious development of science in modern times on human reason's myth-making suggestibility and natural lust for facility. Common consciousness was to expect from science the solution to every problem, and to mistake the progress of science for the advent of a new metaphysics and religion. First of all, philosophers were either to construct pseudo-metaphysics that were but spurious extrapolations of science, or to betray philosophy in repudiating metaphysics, assuming that what has no meaning *for the scientist* has no meaning *at all*, and making reason a mere operator of sensory devices.

5. Science itself provides a remedy. First, because it preserves and treasures, on its own level, the sense of truth and of rational objectivity.

Second, because—despite the deontologized character of science *made—science in the making*, I mean the pioneering scientist, the great discoverer, the man of vision, who renews scientific concepts, is quickened by a power of poetic insight and a thirst for being that science itself cannot satisfy, and which incite him toward questions that are beyond the scope of science: determinism and freedom, matter and spirit, the origin and destiny of the universe, the existence of God.

IN THIS connection we must pay great and respectful attention to the experience of many contemporary scientists who have been led by their meditation upon science either into the philosophical or the religious realm. Yet one cannot properly answer philosophical questions without genuine philosophical equipment. The next step for such scientists is to become themselves philosophers, and to recognize the autonomous sphere of philosophical truth.

6. Thus a serious possibility exists that a reconcilation of science and wisdom may be achieved in a number of minds. But as to our civilization as a whole this would require in our contemporaries a vigor and range of intellect the probability of which seems to be questionable.

In the moral field:

7. Science and technology provide us with means. The determination of the human ends for which those means are to be used pre-supposes knowl-

edge of *what is man* and *what is the meaning of human life*, and this is not the job of science and technology, but of metaphysics, ethics, and religion.

8. Science and technology, considered in their very natures, are not responsible for the moral crisis of our time, nor for the destructive or besotting and dehumanizing use we are making of the means that they put in our hands, nor for the civilization technocratic in type which worshippers of technology wish to prepare for us.

9. What is responsible for the crisis is greed and will to power, and the temptation to which the kind of an omnipotence meted out by science and technology gives rise in the human race, which has not yet succeeded in submitting to reason the behavior of man, especially collective man. Thus the human person is threatened today with all-pervading slavery, not through the fault of science, but through that of the enlarged power granted by science and technology (that is, by reason mastering natural phenomena) to human foolishness.

10. The moral problem thus faced by the scientist, his sense of responsibility toward the human community, his realization of the fact that mankind equipped with technology cannot survive without ethical wisdom, are making for him the rediscovery of the true ends and supreme standards of human life a matter of emergency. Such a rediscovery cannot be brought about by science itself, but by ethical awareness and ethical philosophy, and religious faith. So a trend is developing within the scientific world toward a wisdom and a spiritual unification of man that are beyond the scope of merely scientific work.

11. Where it is a question of moral recovery, not only reason but all the highest spiritual activities in man must be called to work. As Bergson put it, the world's body, now larger, calls for a surplus of soul, so that the mechanical and the mystical summon one another. In other terms, technology can really perform its task of human liberation only if the sense of inner freedom and contemplative love is made by the Gospel's inspiration to play a leading part in the new industrial civilization.

COMING now to what I have called the *social issue:*

12. Since science's competence extends to observable and measurable phenomena, not to the inner being of things, and to the means, not to the ends of human life, it would be nonsense to expect that the progress of science will provide men with a new type of metaphysics, ethics, or religion. The development of the scientific spirit, and the progress of science and technology, improve in an invaluable manner the inner, intellectual, and moral, as well as the external and material, equipment of human life. Yet it is up to ontological knowledge, not to science, to judge of the values, norms, and ends which make human life simply good or bad.

13. However important and indispensable the action of ideas, of philosophical understanding and religious enlightenment may be for the destiny and possible recovery of the world, the issue, as soon as it is a question of the collective life of men and of the attitude of mass consciousness, shifts for a considerable part from the realm of truth to be known to the realm of historical and social achievements to be attained. Thus, by a kind of pseudomorphosis, problems which in themselves are philosophical or spiritual become posed in or transposed into social terms. If man were to lose terrestrial hope in the Gospel, I am afraid our hope in a spiritual recovery of civilization would be doomed to disappointment.

14. Will the progressive transformation of society that we are facing today be able to manifest the power of freedom and justice and of spiritual energies by securing both the technological structure of our emergent civilization and its supra-technological guiding inspiration, the organization of the world, and the individual liberty as well as the autonomy of groups starting from the bottom, the accession of new classes to ownership and power and the freedoms claimed by science and intelligence in quest of truth, as well as by the word of God in quest of human hearts?

15. If the efforts made toward such an historical ideal are to succeed, a general recovery can be expected, extending to the highest functions of the human spirit. If those efforts are to be a failure, a general worsening in our spiritual condition is to be expected—whoever the winners in the political game may be—with a general domination of materialism and a general enslavement of the human person. The truth and the high requirements of art and poetry, science and philosophy, religion and spirituality, would continue to be served but in the catacombs of human history, and under the conditions of a suffering diaspora.

Large-Scale Research

(Continued from page 191)

which may be open to attack as vague and arbitrary, is far from solution.

Brilliant individualists. Closely connected with the previous problem is that arising from the anarchic disposition of many brilliant creators. Some way must be found to relax, in their case, the application of various otherwise strict regulations without which a big organization cannot function and which deal with such matters as hours of access to the laboratory, rules of borrowing from the library, and rotation schemes for annual leave.

Academism. Scientists with a strongly ingrained academic past are sometimes tempted to claim all the advantages brought by the new kind of organization—access to vastly enlarged facilities, higher salaries, wider scope, sympathy of public opinion—and yet to cling to formerly enjoyed advantages such as freedom of interests, longer holidays, absence of responsibility for other people's work, and the privilege of viewing every question in a detached and purely intellectual light.

A variant of the same problem arises from the fact that big research organizations attract an increasing proportion of young scientists, who are preoccupied with their academic future. Ph.D. requirements lay stress on individual achievement, and if the young scientist does not renounce the Ph.D. trail for good, or if he is not sure to encounter later on an understanding faculty, he may be driven, in his daily and necessarily collective activity, to an attitude of isolationism and a propensity for hogging the credit. It may become necessary for universities to revise their whole conception of a valid Ph.D. thesis in the light of the new developments.

Cliques. In the milder form of the disease, exclusive ties of loyalty come into being among a restricted number of persons bound together by the common exercise of some esoteric technique, a highbrow hobby, or simply mutual admiration. Segregation breeds resentment from outside, and soon the clique finds itself on a defensive warpath. In the later stages the clique becomes aggressive and resorts to proselytizing and propaganda, and its boundaries tend to coincide with those of divisions or of political groupings. Thus reinforced, the separatist tendencies may grow until they threaten the very existence of the establishment.

(Continued on page 204)

WHY ANOTHER CYCLOTRON?

Lee A. DuBridge

The following address was given at the University of Rochester on March 29, on the occasion of the dedication of the new 130-inch cyclotron. Professor DuBridge, formerly head of the Physics Department at the University of Rochester, and wartime Director of the Radiation Laboratory at the Massachusetts Institute of Technology, is now President of the California Institute of Technology.

WHEN we built our first 27-inch cyclotron at Rochester in 1935-36, I often used to be asked the questions, why build a cyclotron? Of what use is it? Why smash the atom anyway? In many a speech given before various groups around the city of Rochester I tried to set forth the answer.

What was the answer then? And what is it now?

Curiously enough the answer — though it is a little easier to give today—is basically the same as it was then.

We were not smashing atoms in 1937 to make an atomic bomb or a nuclear power plant. The idea never entered our heads even in our wildest dreams. Our little Rochester cyclotron was not built with any particular practical end in view. It was built because a new field of science was then opening up, and the cyclotron provided a powerful new tool for exploring this field. Our objective was only to make a little excursion into this unknown area—to add maybe a little bit to man's knowledge about it.

Ever since men first appeared on this earth they have been prying into the unknown. This is the outstanding characteristic which distinguishes man from beast—this insatiable curiosity. We are all born with it—and curiosity is one of the earliest evidences of dawning intelligence in children. If many a growing adult loses his childhood curiosity, this is only a matter for great sadness. There is so much to know in the world that a person who has lost his curiosity has ceased intellectually to live.

Man's curiosity, of course, may take many forms. Some men become explorers into unknown areas on the earth's surface—the Arctic, the Antarctic, the jungles of Africa, the top of Mt. Everest. Others have a burning curiosity to know more about how men lived in past times, or to understand the basic factors governing the way in which men live together today. Others of us are just curious about what our neighbors are doing. All of us are curious about what goes on behind the Iron Curtain in Europe. Any blank wall is always a challenge to investigate.

Then there are some individuals whose curiosity leads them to the exploration of the laws of nature. Another iron curtain, which until a few years ago, obscured our vision about what goes on inside the atomic nucleus, was an irresistible challenge to many men to find methods of penetrating that curtain, and learning the nuclear secrets.

In the 1930's the cyclotron proved itself a superb weapon for piercing this nuclear curtain. Therefore, it was no bold stroke of genius which led us to build a cyclotron at Rochester in 1935. Quite the contrary, we were simply yielding to an irresistible temptation.

Then in 1939 as we were busily and happily engaged in our game of puncturing holes in the nuclear iron curtain, the rumblings of trouble in Europe culminated in the blinding flash of the beginning of hostilities. For several years we physicists, like everyone else, had been only dimly conscious of trouble in Europe and felt that it would probably not affect us. And yet we were uneasy. From time to time, distinguished physicists from Europe had been migrating to this country, some ejected because of their race from their positions in Germany, others simply no longer able to tolerate the threat to intellectual freedom which was daily growing there. We welcomed these distinguished additions to the American scientific family.

From these men we gradually learned enough to realize that the outbreak of hostilities in Europe was more than a far-away storm. If the Nazis should succeed in their goal of world conquest, then intellectual freedom, personal and political freedom, and man's insatiable curiosity to know would be promptly suppressed. There would be no science and there would be very little of anything else that we cherished if Hitler ruled the world. Curiosity is a dangerous thing to a dictator, to *any* dictator. One of the first things he does is try to suppress it.

It is not surprising, therefore, that the scientists were among the first to volunteer their services to their country to prevent the spread of a world dictatorship. I need not repeat here the story of what went on during the war years. Everyone is familiar with it.

At the end of the war, when the information about the atomic bomb, about radar, about proximity fuses, and many other technological achievements which had played such an important role in the victory, was released to the public, no one any longer needed to apologize for being a scientist, or for being interested in research. Scientific research, because of its practical contributions, suddenly became respectable. Scientists became almost national heroes. New developments in scientific research became front-page news. Even the man in the street now realized that the quiet and seemingly highly abstruse work of the scientist in his laboratory might be significant after all. It had some practical use. It helped win a war.

NOW what about all this sudden, shall I say, notoriety which came to science and to scientists? Was it good, or was it bad?

Frankly, though the answer is a little bit of both, the effects were good on the whole. Unfortunately, a few scientists (and fortunately only a few) were not as cautious in their public statements on the problems of economics, politics, international relations, as they usually were on the problems of

science. On the other hand, it was a good thing to have the scientists jarred into the realization that they could no longer isolate themselves from the world, within the four walls of their laboratories. There were national and international issues arising which involved, not only the facts of science, but also the activities and freedom of scientists. On these issues the voice of the scientists needed to be raised, and it was raised in what was generally an intelligent and effective way.

THE net result of the war, I think, was that scientists are today somewhat more human individuals, somewhat more intelligent citizens, somewhat broader minded in their understanding of nonscientific problems, somewhat more willing to play their part as citizens than they were before the war.

The effects of war on science itself were also both good and bad. Unfortunately, the spectacular achievements of the war years led many people to believe that the sole function of science was to develop either weapons of war or the gadgets of peace. Radar, rockets, and the atomic bomb, together with plastic automobiles, nuclear power plants, and television sets were regarded as the sole products of science, the reason for its existence, or the chief currency with which to measure its value. The atomic bomb being an obviously impossible achievement, it now became evident to many people that any impossible achievement could also be accomplished by science. It was all only a matter of money and laboratories. If men wanted to cure cancer or ride a rocket to the moon, science should accomplish it tomorrow, and if tomorrow did not see the miracles accomplished, it was because of the inefficiency or the laziness of the scientists, or because the government did not furnish enough money.

All of this is bad for science, for it represents a misunderstanding of its aims, methods, and function. And since science depends upon the general public for support, it is important that the public appreciate what science is for, what it can and cannot do. This cloud of misunderstanding about the function of science was an unfortunate result of the war.

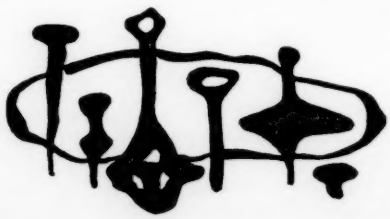
On the other hand, the public prestige which has been accorded to science and scientists in these postwar years has its good aspects. It is true that many people do understand more clearly than before what the role of science is in modern civilization, and on their understanding the future hopes of science will rest. But because this understanding is not universal I never apologize for talking about it again.

THIS brings me to the task of trying to state as clearly and concisely as possible my own conception of the place of science in our society. Just what are the science laboratories of our universities trying to do? What will be the results of their work? What is the purpose of the great scientific laboratories of industry—of the government? Why has a great new cyclotron been built at a cost of over a million and a half dollars, and with an annual budget approaching a half million dollars a year at the University of Rochester?

To state this problem clearly, we must distinguish between the role of what we have come to call pure or basic science, and the role of what we call applied science. We must distinguish, in other words, between science itself and the applications of science.

POSSIBLY I can explain this best by referring to an analogy. A steel mill is built to make steel. As the bars of steel come out of the mill they are not labeled as to whether they shall be used for battleships or tanks or trucks or guns or plows. Steel is a raw material. It will be fabricated into whatever structures, gadgets, devices, or weapons are most in demand at the moment. Much of the steel will be wasted. Some will go into useless devices, but much will go into things that improve the happiness, comfort, or security of men and women.

Similarly, a science laboratory is a producer of raw material. That raw material is *knowledge* about the physical world. It may be knowledge about the structure of the atomic nucleus, about the function of genes or chromosomes, or viruses or enzymes. It may deal with the propagation and behavior of electromagnetic waves, or with the chemical structure of certain compounds. The main purpose of the scientific laboratory is to produce knowledge in some field. It is to explore the unknown. It is to elicit a few more of nature's secrets.



Now it is the universities of the world in which this production of new knowledge is proceeding most actively. It is in the universities that the goal of seeking knowledge for its own sake is the primary and not a secondary goal. It is in the universities that men and women are free to explore whatever fields excite their curiosity, to seek whatever new knowledge challenges them as individuals, to make this knowledge available to the world at large.

How is all this knowledge to be used? Here again, as in the case of steel, our knowledge does not come labeled as to whether it shall be used for good or evil purposes, whether it shall be used to improve or degrade the happiness of men, whether it shall be used to devise weapons of war or cures for a dread disease. Though knowledge is often sought specifically because of the hope that it will be useful in a particular practical way, it is frequently true that knowledge sought for one purpose is found eventually to be of more use for a totally different purpose. Roentgen was not playing around with evacuated glass tubes in order to find a way of mending broken bones, but the X-rays which he discovered proved one of the most powerful tools ever developed for medical work. In short, how knowledge is used is usually determined after the knowledge has been secured and not before. The first task is to gain knowledge. The second is to determine how to apply it.

HERE is where the laboratory of applied science comes in—such as, for example, the great industrial laboratories of this country and many of the government laboratories. Their primary task is not to seek knowledge but to use knowledge already gained to solve a particular practical problem. This, of course, requires scientific skill and competence of the highest order. It is just as important for mankind that knowledge be put to use beneficially as that it be discovered in the first place. But discovering primary knowledge and putting it to use are somewhat different kinds of tasks. The world has great need of the men and laboratories to do both. But one must be careful not

to glamorize the application of knowledge to the detriment of the search for knowledge itself. We are in serious danger of doing just that today in this country. It is easy to see the importance and to raise the money for developing a cure for cancer or for polio, or for developing new and more effective weapons of defense, for developing new industrial products which will be of use in everyday life. Huge sums are devoted annually by the government and by private industry for exploiting to the full the applications of scientific knowledge. And this is right and proper and necessary.

BUT are we giving adequate attention to those laboratories and those individuals whose goal is the discovery of new knowledge itself? If we do not, our knowledge will be used up and we will be trying to erect a superstructure without first building the foundation. And anybody knows that this is nonsense.

Let us be more specific. What are going to be the practical results of the experiments which will be carried out in coming years with the great new cyclotron at Rochester? The plain truth is that no one can possibly predict. It is not even sensible to waste effort and time to make predictions. The only prediction one can make with assurance is that whatever predictions one does make will be wrong. If you are expecting the cyclotron to yield the design for a new and more powerful atomic bomb you are almost sure to be disappointed. If you are expecting it to bring about the more rapid development of nuclear power plants or a cure for cancer or a rocket which will go to the moon, you will be disappointed also.

What this cyclotron will certainly do is just one thing—it will yield to the skilled physicists who work with it new knowledge about the behavior, the structure, the characteristics of atomic nuclei. And we can be sure of one thing more: that, as new knowledge of atomic nuclei comes out of this laboratory and many other laboratories throughout the world, sooner or later this new knowledge as a whole will have some striking, important, and valuable uses to men. This laboratory here, and other university laboratories around the world, are laying a foundation. It is not yet clear what kind of a superstructure will be built thereon. But it is clear that no superstructure at all will be built unless or until the foundation is laid.

And at this point I must stress another thing about knowledge. Too often we judge the value of knowledge by the new machines or gadgets or weapons it provides. But a more far-reaching effect of knowledge is its effects on men's minds. Is it an accident that the growth of science during the past three hundred years has been accompanied by the greatest emancipation of men's minds the world has ever seen? Is the fact that machines have been developed to free our muscles of labor more important than that ideas have been developed to free our minds of superstition and fear? Knowledge is a dangerous thing—not because it leads to atomic bombs but because men who can understand the universe do not want to be slaves. Knowledge is a wonderful thing not because it provides autos and radios but because it makes men free.

FINALLY, at this laboratory, because it is a university laboratory, one more important result will be achieved, namely, young men and women will be gaining a superb education in the field of physical science. The advance of civilization depends upon knowledge, but even more it depends upon men and women. As Robert Oppenheimer has said, "the best way to spread or transmit information is to wrap it up in a person." The best way for an industry to gain knowledge in a new field is not to buy a book, but to hire a man. The men and women trained here and at other universities throughout the country will be the makers of tomorrow. The knowledge which they help to uncover here while pursuing their education may be less important to them or to the world than the fact that they have learned here the techniques of how to gain new knowledge and how to put that knowledge to work.

And so as we celebrate the completion of this great new tool for research, let us not think of it as so many tons of iron and copper, as so many hundred million electron volts of energy, and so many million dollars invested in a great machine. Rather let us think of this great cyclotron as a symbol of the double-ended function of our universities—the search for truth and the education of men and women. This cyclotron is not an end in itself, but a means to an end. The knowledge it helps to uncover will widen the horizon of men's minds. The students who work with it will go out better able to make their contribution to a stronger nation, a more peaceable and a happier world.

The Bulletin's regular report on the activities of the United Nations Atomic Energy Commission has been omitted this month for lack of space. A complete account will be published in the August issue.

AEC Announces Changes in Personnel

Several changes of personnel have been announced by the U. S. Atomic Energy Commission. On April 21, the Commission made public the resignation of Robert F. Bacher, who has accepted an appointment as head of the Physics, Mathematics, and Astronomy Departments at the California Institute of Technology. To replace Mr. Bacher, President Truman has named Dr. Henry DeWolf Smyth, Chairman of the Department of Physics at Princeton University, and author of the official War Department report, *Atomic Energy for Military Purposes.*

Mr. Truman also nominated Gordon Dean, Professor of Law at the University of Southern California, and formerly associated with the Department of Justice. Mr. Dean is to replace W. W. Waymack, who resigned from the Commission on December 23. Both of these nominations were confirmed by the Senate on May 21. The terms of these Commissioners expire June 30, 1950.

The Director of the Security Division of the AEC, Rear Admiral John E. Gingrich, has been recalled to active duty in the Navy, and resigned on May 3. Francis Hammack, Chief of the Personnel Security Branch, has been designated as acting Director until a successor to Admiral Gingrich is appointed.

On May 9, the AEC announced the resignation of John C. Franklin as manager of the Office of Oak Ridge Operations. Mr. Franklin will re-enter private business but continue to serve with the Commission as a consultant on technical and management matters.

Joseph Volpe, Jr., has been appointed General Counsel to the Commission, to succeed Adrian S. Fisher.

Large-Scale Research

(Continued from Page 200)

Empire builders. A forceful division head or sometimes even a mere group leader may use such imperfections as the delimitation of tasks, the haziness of hierarchy, or simply the good nature of his neighbors, in order to increase the domain of his competence and the number of his subordinates, and thus gain prestige and everything which goes with it. To further his aims he usually creates a Clique (see above) and generally poisons the atmosphere to a degree which hardly needs comment. At the same time he tends to neglect his original realm. This latter feature of the Empire Builder's activity is the most harmful, since aggression can be countered, but neglect usually remains uncompensated.

Mystagogues.[12] For obvious reasons, cheating is as easy in science as in income tax returns. The new large-scale organization, in which wielders of rare skills and kinds of knowledge often have to be controlled and supervised by nonspecialists, offers ever-increasing scope to those who fraudulently claim to possess knowledge that no one can assess, or to achieve results that no one can check. Such clever people are skilled in steering their superiors into situations in which the latter are reluctant to admit their incompetence. After that, the stage is set, and those who have at least enough understanding to suspect the truth, helplessly watch the fraud ascend the scale of hierarchy and successively gain positions in which he is more and more likely to escape detection.

A genuine scientist is eager to establish his reputation among those who know his subject; a Mystagogue builds his among those who do not. This simple criterion may help in the exercise of that constant watchfulness without which the establishment cannot be kept a healthy and going concern.

My list of diseases may fittingly end with the description of this particularly dangerous germ. We may deplore its increasing virulence, but we may also take it as an indirect tribute to the increasing importance of organized research on a national and international scale.

[12] "But the mystagogues hide a thing in darkness and secrecy and when you find it, it's a platitude."—G. K. Chesterton, *The Incredulity of Father Brown.*

BOOKS

Histopathology of Irradiation from External and Internal Sources. Edited by WILLIAM BLOOM. ("National Nuclear Energy Series, Manhattan Project Technical Section, Division IV, Plutonium Project Record," Vol. XXXII, 1.) New York: McGraw-Hill, 1948. Pp. xxv+808. $8.00.

THIS volume, one of the series prepared as a record of the research work done under the Manhattan Project and the Atomic Energy Commission, embodies in some 800 pages the experiments done on animals with various forms of ionizing radiation. This represents selection and condensation from the enormous mass of data built up at a time when both time and scientific personnel were at a premium. The authors over-emphasize, if anything, the shortcomings and the gaps in the data. Their cautiousness and awareness of problems still to be solved make the reading of the report of added value.

The book includes an Introduction and a summary by Dr. Bloom and seventeen chapters which discuss Material and Methods, The Cell, The Skin, Bone, Bone Marrow, The Spleen, Lymph Node and Intestinal Lymphatic Tissue, The Thymus, The Gastro-intestinal Tract, Structures Accessory to the Gastro-intestinal Tract, The Testis, The Ovary, The Kidney, The Lung, The Vascular System, The Adrenal, and The Nervous System. An Appendix lists the experiments giving the type and dose of radiation, the species, the number of animals, and the time intervals. The Bibliography includes most significant references bearing on the subject, including some references to special plutonium project reports.

In general, the external radiation was given as single doses to the entire body of the animals and in amounts at or below the LD 50. Internal radiation from radioactive isotopes was also given in relatively small doses. This has the advantage that the histology of both the phases of injury and the repair processes could be followed. The changes in blood vessels and connective tissue that are well recognized from the use of irradiation therapy in humans are inconspicuous in these smaller doses.

The animals used were rats, mice, rabbits, guinea pigs, and a few chicks. Most of the studies were made on the basis of hematoxylin-eosin sections, and one wonders what added information

histochemical studies might provide. The distribution of internal emittors is demonstrated by a fair number of radioautographs.

All these experiments in common with most of those performed in recent years indicate that there is no initial stimulating effect on cellular proliferation from ionizing radiation.

The authors are properly cautious in pointing out that the various cellular degenerations seen as a result of irradiation are nonspecific so far as general morphology and cytology is concerned.

It is pointed out in the section on Bone Marrow that the erythrocytic series are most susceptible to radiation, the myeloid series next, and the megakaryocytes least susceptible, whereas in the dosages used the primitive reticular cells were never destroyed. The prolonged action of the internal emittors of relatively low intensity tended to produce abnormal types of myeloid cells and also atypical fibrous bone.

There are many other aspects which should be touched upon would space permit.

In general, this book will prove more useful to the person who has already acquired some competence in the field of the histopathology of radiation than to the neophyte. As source material, it is of great value. No startling alteration from established views has been brought about.

SHIELDS WARREN, M. D.